

# Heads Up: Real News About Drugs and Your Body

**Welcome to Heads Up:** Brought to you by Scholastic and the scientists at the National Institute on Drug Abuse, *Heads Up* gives you the facts about the real effects of drugs on the teen brain and body. Check out the articles and features inside to get the latest news so you can make informed choices about your health and your future.

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**Plus additional supplements to each article**

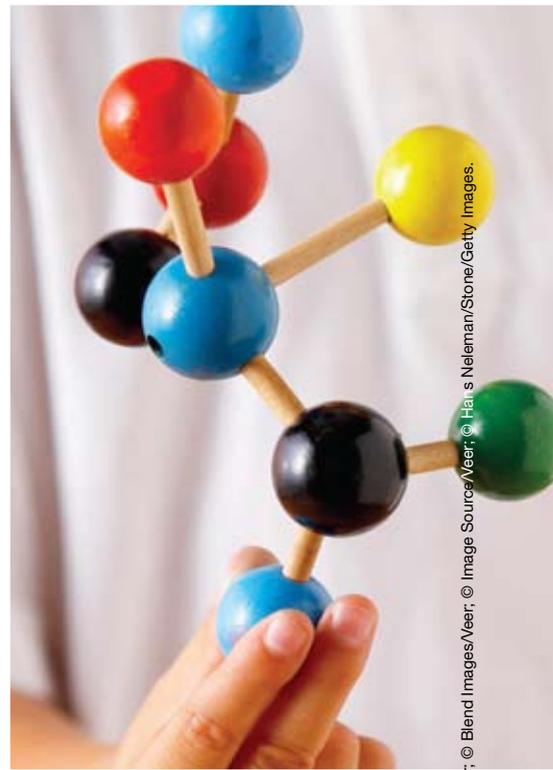
For more real news about drugs and your body, visit [www.scholastic.com/headsup](http://www.scholastic.com/headsup) and <http://teens.drugabuse.gov>.

To order additional copies of this Heads Up Student Edition at no charge, call 1-877-643-2644 and refer to HURN09-07SC or visit [www.nida.nih.gov/scholastic.html](http://www.nida.nih.gov/scholastic.html).

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# Genetics and Addiction

*Scientists are uncovering new information from the field of genetics that will be able to help in the prevention and treatment of drug addiction.*



John Crawford has an identical twin. His 16-year-old brother, Keith, is his mirror image. John has brown hair, brown eyes, and a slightly crooked smile. So does Keith. John weighs about 160 pounds. Ditto for Keith. The brothers walk the same, talk the same—their friends tease them because they even bowl the same. The reason, of course, is that identical twins share exactly the same **genes**, those tiny units of hereditary material (DNA) that carry instructions for forming all the cells in the body and directing their activity. Beyond their physical similarities, the brothers also share less-obvious traits. These range from harmless things such as food preferences—they both love hot chilies—to unseen vulnerabilities, such as a risk for heart disease, diabetes, and drug addiction.

You've probably heard that drug and alcohol abuse runs in families. But what exactly does that mean? John and Keith have a parent who struggles with alcoholism, so are they destined by genetics to face the same fate? The good news is that no single factor determines whether a person will become addicted to drugs. That's because genetics, biology, and environment all influence a person's risk for **drug addiction**, defined as a chronic yet treatable brain disease characterized by compulsive drug seeking and use.

So, while the saying may be that substance abuse “runs in the family,” a whole list of other risk factors in addition to genes come into play to determine whether a person gets hooked. These include *biological* factors, such as genetics, one's age, or the presence of other diseases, as well as *environmental* factors, such as diet, stress, or peer pressure. Neither John nor Keith shares their parent's battle with addiction, but the twins know that their family genetics can increase their risk of addiction.

It may be hard to see how a tiny piece of DNA could influence the risk of becoming addicted. The fact is, however, that scientists have identified several genes that can do just that. In reality, every gene comes in different forms, or **variants**, and researchers have discovered that some of these variants can make people more likely to abuse marijuana, heroin, cocaine, and other illegal, as well as legal, drugs. Certain genes

## WHO BECOMES ADDICTED?

These key factors are involved in the question of who becomes addicted to drugs:



**BIOLOGY:** The genes that someone is born with—in combination with environmental factors—account for about half of a person's risk for drug addiction. Other biological factors

include a person's gender, ethnic background, whether there are mental disorders present, and how each drug affects each person's unique biology.

Developmental stages also affect one's addiction vulnerability. Here, adolescents face a double challenge: One part is that the earlier that drug use begins, the more likely it is to progress to more serious abuse. The other part is that adolescents' brains are still developing in the areas that govern decision making, judgment, and self-control. Because of this, teens are especially prone to risk-taking behaviors, including trying drugs.



**ENVIRONMENT:** Environmental factors can be broken down into two categories. “Risk factors” include those that make drug use more likely. Examples include lack of

parental supervision or chaotic home environments; substance abuse at home; associating with peers who use drugs; and even the availability and cost of drugs. “Protective factors” reduce the potential for drug use. Examples include parental monitoring and involvement; strong neighborhood, community, or school attachments; or strong family connections.

Assessing personal risk is a complex issue—and risk factors for one person may be quite different from those for another. However, eliminating risk factors, or increasing protective factors, are actions that can help keep you safe from drug abuse. ●●●

## Genetic information will help to identify who may be at greater risk for addiction, and suggest targets for innovative medications to treat those who become addicted.

can actually influence the way in which a person responds to drugs.

For instance, Harvard University scientists recently studied twins to gauge their responses to marijuana. They studied 352 pairs of **identical twins** (like Keith and John, these twins developed from one fertilized egg and share the exact same genes) and 255 pairs of **fraternal twins** (siblings who developed from two fertilized eggs in the womb at the same time and have different sets of genes). All the study participants admitted to having smoked marijuana more than five times in their lives. On a questionnaire in which the participants were asked to rate how “good” or “bad” the drug made them feel, the answers of the identical twins were significantly more alike than those of the fraternal twins.

This finding suggests that genes can have a major impact on the effects of a drug once it is introduced into the body. A specific example comes from studies of the

enzyme “CYP2A6.” Research has found that people have a greater resistance to nicotine—the addictive drug in tobacco—if they have a genetic variant that decreases the function of CYP2A6. The decrease in CYP2A6 slows the breakdown of nicotine and protects individuals against nicotine addiction. This case illustrates that genetic variants can not only increase the risk of addiction, but can sometimes also lower it by protecting someone from the effects of a drug, for example.

First identifying which genes are involved in the addiction process, then determining which forms of those genes increase the risk—and which are protective—is serious business. Genetic information will help to identify who may be at greater risk for addiction, and suggest targets for innovative medications to treat those who become addicted. And, just as important, knowing one’s genetic risks, like John and Keith Crawford do, helps in making smart choices. ●●●

### Vocabulary

Match each word in Column A to its meaning in Column B.

#### COLUMN A

1. **genes**
2. **drug addiction**
3. **variant**
4. **identical twins**
5. **fraternal twins**

#### COLUMN B

- A. siblings who developed from two fertilized eggs and who share different sets of genes
- B. siblings who developed from one fertilized egg and who share identical genes
- C. tiny units of hereditary material (DNA) that carry instructions for forming all the cells in the body and directing their activity
- D. a chronic brain disease that affects the way you think and behave
- E. one of a number of specific forms that can be displayed by a gene

# Do You Know Your Risk for Addiction?

Research shows that a complex set of biological and environmental risk factors contributes to someone's risk for drug addiction.

**D**rug addiction is a complex disease that has serious, harmful effects on a person's health and on his or her social relationships. How does a person become addicted to drugs? The answer is not so simple—no single factor determines whether a person will become addicted to drugs. Drug addiction is defined as a treatable brain disease that makes it difficult to resist drug use. The risk factors that contribute to addiction are biological or environmental, or many different combinations of both types of factors.

Research shows that drug abuse usually begins in adolescence. There are several reasons for this. For one, the parts of the brain that control judgment, self-control, and future planning do not fully mature until young adulthood. As a result, the teen brain is wired for risk-taking and experimenting. Trying new things is part of the process of maturing and developing the brain's ability to evaluate risk and make decisions. Another important reason why drug use frequently begins in adolescence is that teens are often strongly influenced by their peers, who may convince them that "everybody's doing it."

The good news is that teens can control factors that put them at risk of engaging

in harmful behaviors, such as drug abuse. However, in order to do so, teens need to understand what those risk factors are.

## Biological Factors

A person's unique biology—his or her genes, age, gender, and other factors—plays a role in his or her risk of experimenting with drugs and becoming addicted. Biological factors that can contribute to someone's risk for drug abuse and addiction include:

**Genetics.** You may have heard that drug and alcohol addiction can run in families. This is true, but just because someone in your family has struggled with addiction does not mean that you are destined to do the same. However, having a family member who has experienced addiction does mean that a person may be at increased risk of becoming addicted if he or she chooses to take drugs in the first place. Genes, combined with other factors, are estimated to contribute about 40%–60% of the risk for drug addiction.

**Developmental stage.** Research shows that the earlier a person begins to use drugs, the greater the risk for addiction later in life. There are likely many reasons for this, but one is that the human brain undergoes dramatic changes during adolescence, which continue into early adulthood.

Teens' brains are especially at risk because they are still maturing. Drugs exert long-lasting influences on a developing brain that can increase a person's vulnerability to later drug abuse and addiction.

**Sensitivity to drugs.** Have you ever noticed how some people can drink a caffeinated beverage and it has no effect on them, while others are bouncing off the walls and can't sleep? People have different sensitivities to a drug's effects—in fact, what one person likes, another may hate. These differences affect the likelihood that someone will continue to take drugs and become addicted to them.

**Mental illness.** Mental disorders, such as depression, anxiety, attention deficit hyperactivity disorder (ADHD), and others, may put people at greater risk for using drugs and becoming addicted. There are many possible reasons for this increased risk for addiction. One is that some people with mental disorders take drugs because the drugs make them feel better, or they believe the drugs help them deal with their problems. Also, mental disorders affect the same brain circuits and chemicals as do drugs of abuse. The overlapping effects of a mental disorder and a drug may increase the risk for addiction.

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Photo: © pixland/Corbis.



# Teen Science- Investigators

Three teens' remarkable research projects help reveal the science behind drug abuse and addiction



Volunteering in a hospital in Texas, 17-year-old Kapil Ramachandran saw a patient admitted for an overdose of narcotics and alcohol. “What would possibly drive someone to inflict so much pain on themselves and their family?” he wondered. In Oklahoma, 17-year-old Ethan Guinn had read about the growing problem of video-game addiction in teens. Knowing how often he played, he wondered, “Do I have a problem with addiction?” In Florida, 15-year-old Shelby Raye noticed how some of her friends seemed “cool,” others not. Raye wondered, “How are perceptions of coolness shaped? Is there a coolness factor?”

These teens had one thing in common: They were curious about something in the world around them and sought out answers to their questions. Sound easy? Not so fast. Being curious is only the first step. Scientific research involves taking a question at hand and exploring a hypothesis (a proposed explanation that can be tested), and then testing that hypothesis to come away with answers—and perhaps more hypotheses.

In their search for answers, each of these teens conducted unique and highly creative research, from the molecular level to the behavioral, which contributes valuable knowledge to addiction science. In recognition of their achievements, each was honored with a NIDA-Scholastic Addiction Science Award at the 2008 Intel International Science and Engineering Fair (ISEF), the premier science competition in the world for high school students. Read on for more about these extraordinary teens and why their curiosity about the world around them, methods of research, and eventual discoveries in addiction science may have relevance for you.

# FRUIT FLIES AND ALCOHOL ADDICTION

Kapil Vishveshwar Ramachandran



Kapil's questions about what could propel someone to addiction despite its devastating consequences led him to a novel experiment with fruit flies. Working in a laboratory at the University of Texas, he was able to show that the deletion of a specific protein, called Diazepam Binding Inhibitor (DBI), prevented the flies from becoming tolerant to alcohol's behavioral effects. Tolerance, in this case, means that the flies are less affected by the alcohol the second time they are exposed to it, compared to the first. This is important because the ability to develop tolerance goes hand in hand with the risk of becoming addicted to a substance.

Kapil, from Austin, Texas, hopes his findings about DBI will lead to the development of new medications to treat alcohol abuse and addiction in humans. "A lot of teens don't realize that drugs and alcohol can cause incredibly long-term physical changes in their body. Drugs can change the way your neurons fire," he says. "If teens knew this, they might reconsider their actions." Next up for Kapil: Duke University, where he'll study biomedical engineering and neuroscience.



Photos, clockwise from bottom left: © iStockphoto.com; Courtesy of John Guinn; Courtesy of Tejasvi Srivangipuram; © David Scharf; © RubberBall/Veer.

# VIDEO-GAME ADDICTION

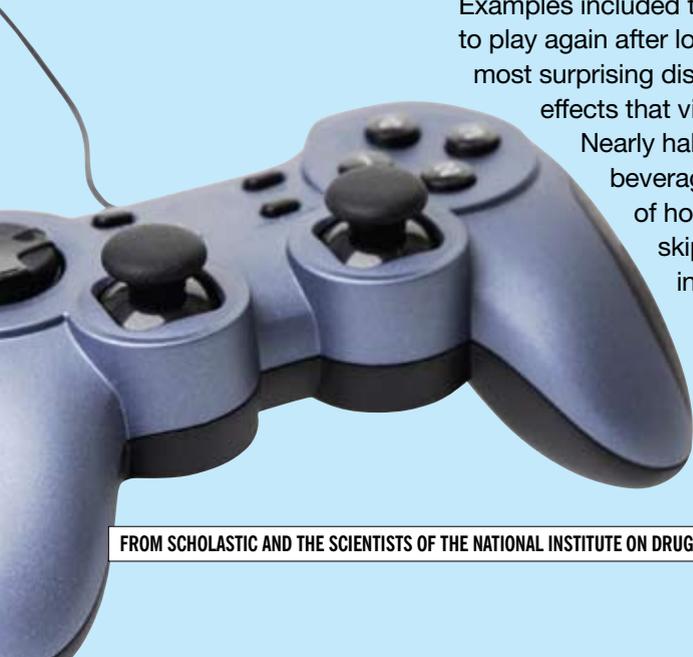
Ethan Guinn



Ethan studied 385 students to see whether the rising popularity of video gaming was, in fact, becoming an "addiction" in some players and, if so, how it impacted their lives. Using criteria that diagnose other addictions, he determined that 62 percent of respondents showed some signs of video-game addiction. Examples included thinking about the games when not playing, feeling driven to play again after losing, or feeling irritable or listless when unable to play. "The most surprising discovery," according to Ethan, "was the number of negative effects that video games had on people's health and social skills."

Nearly half of the students said they consumed junk food and sugary beverages while gaming, and nearly one-third reduced the amount of homework they completed. Others admitted to lying, stealing, skipping school or work, and failing to bathe or brush their teeth in order to play video games.

Ethan, from Moore, Oklahoma, hopes his research will help alert the public to the seriousness of this problem, with the ultimate goal of preventing it and treating those already afflicted. Next up for Ethan: His dream is to become an animator for Pixar Animation Studios or a science teacher.





## WHAT'S COOL?

### Shelby Raye

Shelby surveyed 389 teens at her high school, ages 14 to 18, to determine what makes someone “cool.” She looked at five areas that she suspected might be important: athletics, academics, social relationships, personal qualities, and risky behaviors. She also looked separately at male and female responses. All teens thought that participating in athletics was cool: football was rated highest for guys, and cheerleading/dance was rated highest for girls. Almost half of the students surveyed felt that GPA was not a factor in coolness. The coolness of risky behaviors—smoking and drinking—tended to increase as the students got older, and peaked among 17-year-olds.

Shelby, from Bradenton, Florida, hopes her research will help teachers and parents better understand what motivates teens. “Social perceptions of coolness may act as strong motivators or deterrents for specific behaviors,” Shelby says. Her research points out that teens may engage in risky behaviors as an easy, yet dangerous, way to distinguish themselves as cool. She hopes this information can be put to practical use in helping to identify students at risk, and to prevent the escalation of substance-abuse problems. Next up for Shelby: further studies in physics, chemistry, and psychology as she prepares for college—three years away.



## Awards for Teen Science Projects

The NIDA-Scholastic *Addiction Science Awards* were given for the first time this year for exemplary projects that advance addiction science. They were presented at the Intel International Science and Engineering Fair (ISEF), the premier science competition in the world for high school students. These projects were chosen from among dozens of others on such intriguing topics as the hidden risks of caffeine, the effects of cocaine over a period of use, and even “sand-eating” addiction in Western Africa. “We were thrilled at the quality of projects that explored addiction science,” says lead judge Lucinda Miner, deputy director of the Office of Science Policy and Communications at NIDA. For more information about addiction-science topics and how to enter next year’s *Addiction Science Award* competition, visit [www.drugabuse.gov/sciencefair](http://www.drugabuse.gov/sciencefair).

## After Reading

- What is the importance of studying something like DBI in fruit flies?
- Why is video-game addiction a serious problem for teens?
- How might understanding teens’ perceptions of *coolness* help prevent drug abuse and addiction?
- What unique perspective do you think teens bring to addiction-science research?



### Web Extra

Make sure to check out the complete interviews with these three teen science-investigators at [www.scholastic.com/headsup](http://www.scholastic.com/headsup).

# In Their Own Words: Teen Science–Investigators

Q&As with the teen winners of the NIDA–Scholastic *Addiction Science Awards*

**K**apil Ramachandran, Ethan Guinn, and Shelby Raye were each awarded a NIDA–Scholastic *Addiction Science Award* at the 2008 Intel International Science and Engineering Fair (ISEF), the premier science competition in the world for high school students. The students were honored for exemplary projects that contribute valuable knowledge to addiction science (the study of addiction and its health consequences). *Heads Up* talked with the three young scientists to learn more about the inspiration for their projects, their views on teens in science, and their goals and interests beyond their science achievements.

## Kapil Vishveshwar Ramachandran, 17

Austin, Texas

*Fruit Flies and Alcohol Addiction*



*Kapil, from Westwood High School in Austin, Texas, won first prize and a cash award of \$2,500 for his project, The Novel Role*

*of the GluCl- $\alpha$  Ion Channel and Diazepam Binding Genes in Alcohol Addiction. Working with fruit flies in a laboratory at the University of*

*Texas at Austin, Kapil was able to show that the deletion of a specific protein, called Diazepam Binding Inhibitor (DBI), prevented the flies from becoming tolerant to alcohol's behavioral effects. (Tolerance, in this case, means that the flies are less affected by the alcohol the second time they are exposed to it, compared to the first time.) Kapil's findings are important because the ability to develop tolerance goes hand in hand with the risk of becoming addicted to a substance.*

**Heads Up:** What are your favorite hobbies?

**Kapil:** Tennis, music, drinking coffee, and taking walks in peaceful environments.

**Heads Up:** What's your dream job?

**Kapil:** I've always wanted to be a neurosurgeon.

**Heads Up:** What sparked your interest in studying addiction?

**Kapil:** A few years ago I was volunteering at a hospital (manning the information desk, folding sheets, basic busywork) when a patient came in who had overdosed on narcotics and alcohol. Seeing her made me wonder, “Why would someone drive themselves to create so much pain for themselves and their family? What’s

the biological basis of addiction?” I wanted to work in a laboratory, so I started cold-calling professors. After thirty or so “Nos,” I finally got a “Yes.” When I started the work I had no idea that I could even enter a competition. I was motivated by pure curiosity. At that point, I thought becoming a doctor was my only option. I thought PhDs were only for people much smarter than me. Now I know that ordinary high school students can motivate themselves to do such work.

**Heads Up:** What inspired you to tackle your particular topic?

**Kapil:** I started working in a laboratory at the University of Texas at Austin, which has a whole section devoted to addiction research. What caught my eye was that you could approach addiction science from a broad perspective, from behavioral science to molecular genetics. Only by looking on the outside can you diagnose what’s on the inside.

**Heads Up:** What finding most surprised you?

**Kapil:** I was most surprised to discover that a single protein could influence the risk of becoming an alcoholic.

The protein I studied is called the Diazepam Binding Inhibitor (DBI).

It's found in humans and in fruit flies. There have been only a few human studies of this protein and its role in addiction.

We see high levels of DBI in flies that are addicted to alcohol. (Flies are not naturally alcoholics, of course. But scientists can create an addiction to alcohol in a fruit fly model for research purposes.) The higher the protein level, the greater the addiction.

I developed an experiment to measure alcohol tolerance in fruit flies—as a sign of addiction risk. It's called a “wake-up assay.” Basically, I looked at how fast fruit flies wake up from sedation caused by alcohol. The second time that a fly that has the DBI protein is exposed to the sedating effects of alcohol, it wakes up faster than the first time. The protein DBI appears to help the fly to develop tolerance to alcohol's effects. On the other hand, a fly that does not have the DBI protein takes as long to wake up the second time it is sedated with alcohol as the first time. A fly that does not have the DBI protein does not become tolerant to alcohol's effects (\*see footnote at the end of this interview).

Of course DBI affects more than just alcohol tolerance. Now I'm studying to find out what else might happen when DBI is removed.

**Heads Up:** What was the hardest part about the project?

**Kapil:** I worked on the study for a year and three months. In science you never know what's next. That's the biggest challenge. You have to figure out what steps to take to reach the next goal.

**Heads Up:** Any future plans to study science?

**Kapil:** I'm going to Duke University to study biomedical engineering and neuroscience. It's safe to say that science is my calling.

**Heads Up:** Why do you think it's important for teens to understand the science behind drug addiction?

**Kapil:** I suspect most teens today think that there's no science behind drug addiction. You get high and that's awesome. What's the big deal if a protein level goes up? But what they don't know is that these things cause incredibly long-term changes. Drugs and alcohol can change the way your neurons fire. They can create fundamental long-lasting changes [in your body]. If teens knew this, they might reconsider their actions.

**Heads Up:** What do you think a teen perspective brings to the study of science versus an adult perspective?

**Kapil:** I've talked to teens who are struggling with drug abuse, and I think it makes a difference when you speak eye to eye with a fellow teenager. Maybe that interaction by itself is enough to cure their problems. You never know.

**Heads Up:** How do you think science and scientific research has helped other parts of your life?

**Kapil:** Overall it helps me think a lot more logically and [objectively] about problems. [I've learned] that science isn't all about one thing. It's never just about the Krebs Cycle, for example, it's about physics and chemistry and small things. Small things that come into the picture, and then you realize, “I'm using physics and biology.” That was a big eye-opener.

**Heads Up:** What would you say to other students to inspire them to participate in ISEF 2009?

**Kapil:** ISEF was the pinnacle of our small scientific careers. When you stand up on the ISEF stage and look out, you see the future of science. That's always on my mind. I know that in ten to fifteen years I'm going to collaborate with many of the people I met at ISEF.

**Heads Up:** How do you plan to spend your prize money?

**Kapil:** I'm planning to buy a laptop.

**Heads Up:** What's something that people might not know about you?

**Kapil:** They named a minor planet after me. It's called “KapilRama.”

*\*Note from Heads Up: The chances of developing tolerance the first time you are exposed to an abused substance is linked to the risk of becoming addicted to it. Kapil's research helps researchers to better understand the biology behind tolerance. This understanding might lead to new medications to treat alcohol abuse and addiction.*

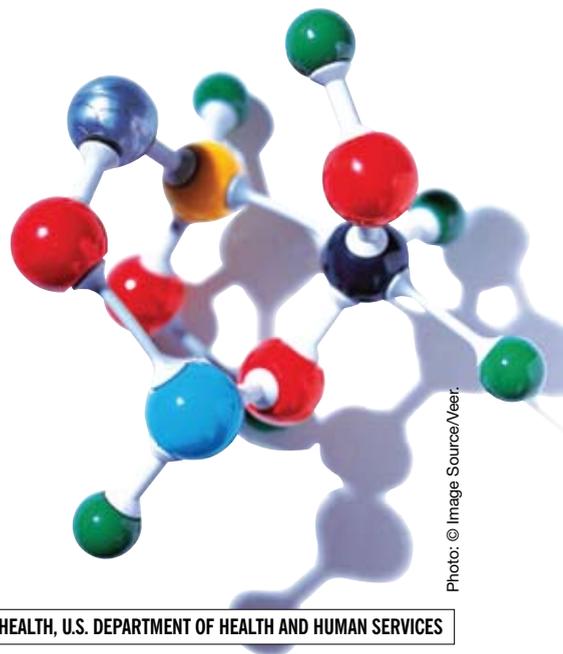


Photo: © Image Source/Veer

## Ethan Guinn, 18

Moore, Oklahoma

*Video-Game Addiction*



*Ethan, from Moore High School in Moore, Oklahoma, won second prize and a cash award of \$1,500 for his project, Video Games:*

*The Next Generation's Addiction. He studied 385 students to see whether the rising popularity of video gaming was, in fact, becoming an "addiction" for some players and, if so, how it impacted their lives. Using criteria similar to those that diagnose other addictions, Ethan determined that 62 percent of respondents showed some signs of video-game addiction. His study also showed that video gaming had negative effects on some players' schoolwork, health, and social skills.*

**Heads Up:** What are your favorite hobbies?

**Ethan:** Video games (ironically), racquetball, watching movies, and writing.

**Heads Up:** What's your dream job?

**Ethan:** I would love to be an animator for a company like Pixar Animation Studios.

**Heads Up:** What sparked your interest in studying addiction?

**Ethan:** I like projects dealing with behavioral science, so I decided that an addiction science project would be a great project to tackle.

**Heads Up:** What inspired you to tackle your particular topic?

**Ethan:** I knew that my topic was [a

growing] problem that was generating a lot of interest. I decided that since I have firsthand experience with the problem, and a large amount of knowledge of the video game industry, [the project would suit me well].

**Heads Up:** What finding most surprised you?

**Ethan:** The most surprising findings were the large number of negative effects of video-game addiction, as well as the extremely large number of people affected by video-game addiction.

**Heads Up:** What was the hardest part about the project?

**Ethan:** The hardest part of my project was inputting the seemingly endless data I had into Microsoft® Excel®, and then graphing the data in a way that it would be easy for anyone to read.

**Heads Up:** Any future plans to study science?

**Ethan:** I would love to continue my research on different age groups, as well as be a science teacher later in life.

**Heads Up:** How do you think science and scientific research has helped other parts of your life?

**Ethan:** My accomplishments with the project have given me a lot of exposure to the scientific community, as well as prizes and good information to put on [my] resume. Honestly, going to the International Science Fair was one of the greatest experiences of my life.

**Heads Up:** What would you say to other students to inspire them to

participate in ISEF 2009?

**Ethan:** I would tell them that ISEF is an experience that is like no other. You meet people from all over the world who have done great things and who are continuing to do great things. ISEF is such a great place to be and it's full of excitement along with competition. Mostly, though, you will gain a sense of pride for your project, respect for your accomplishments, and an untradable experience.

**Heads Up:** How do you plan to spend your prize money?

**Ethan:** I'm actually not sure yet, but until someone from ISEF tackles the gasoline crisis, a lot of it will go toward gas!

## Shelby Raye, 15

Bradenton, Florida

*What's Cool?*



*Shelby, from Manatee High School in Bradenton, Florida, won third prize and a cash award of \$1,000 for her project, What's In*

*and What's Out: High Schoolers' Perceptions of Coolness. She surveyed 389 teens at her high school, ages 14 to 18, to determine what makes someone "cool." Shelby studied five areas—athletics, academics, social relationships, personal qualities, and risky behaviors—to identify factors that determine "coolness." Her research points out that teens may engage in risky behaviors as an easy, yet dangerous, way to distinguish themselves as cool. This information may be put to practical use in helping to identify students at risk, and to prevent the escalation of substance-abuse problems.*

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# STIMULANT ADDICTION

Stimulants, such as cocaine, present serious health risks—they can damage your brain and your body.

Jeremy had always been popular in school. But when he was 13 years old, he began to change. Jeremy started worrying more about whether he was “cool” and if people liked him. “I became shy and introverted,” says Jeremy.

Around the same time, Jeremy began noticing a group of kids at school. He remembers seeing them complaining after class one day, looking very unhappy. Then the students left for lunch. “When they came back, they were laughing and having a great time,” says Jeremy. “I wondered what could make that happen.”

Jeremy began hanging out with the kids and

discovered that they were using alcohol and marijuana, among other drugs. Hoping to capture the happy feeling he had witnessed, Jeremy began using too. When his friends started experimenting with new drugs, including the stimulants cocaine and methamphetamine, Jeremy did too. Jeremy discovered that when he used drugs he didn’t worry so much. “I felt comfortable and accepted,” he says. Jeremy began using drugs, especially stimulants, regularly. “I used them to check out from the problems in my life,” he says. But what Jeremy didn’t know was that these powerfully addictive drugs would soon take over his life.

Photo: © Alto Photography/Veer.

## What Are Stimulants?

Stimulants are a class of drugs that “stimulate” the brain and central nervous system, temporarily increasing energy and alertness.

Not all stimulants are the same. There is great variation in how different stimulants affect the body and how dangerous they can be to your health. The stimulant class of drugs includes a range of substances, such as caffeine, cocaine, nicotine, methamphetamine (“meth”), MDMA (“ecstasy”), as well as the prescription drugs Adderall® and Concerta®, which are used to treat Attention-Deficit Hyperactivity Disorder (ADHD).

## Brain in Overdrive

Like Jeremy, many people start abusing stimulants because the drugs give them an artificial feeling of happiness. “I knew it wasn’t real,” says Jeremy. “But with stimulants, all of my insecurities were taken away.”

When you do something enjoyable—such as eat chocolate or laugh with friends—the brain releases a chemical known as dopamine, which makes you feel good. Stimulants like cocaine interrupt the natural flow of dopamine, causing it to build up in the brain, putting the “reward system” into overdrive (see sidebar).

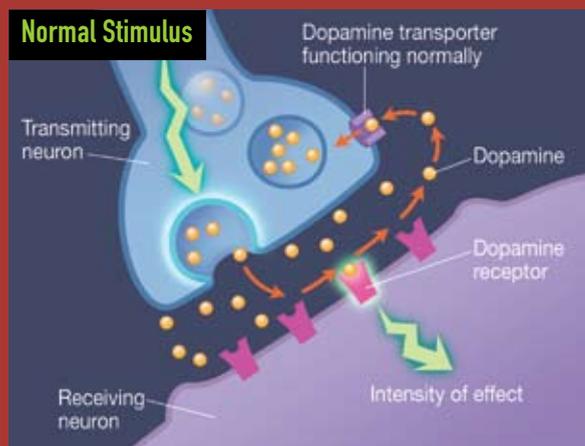
For some users, this causes a powerful but temporary sense of euphoria. Stimulants can also make users feel jittery, anxious, irritable, and paranoid. “One of the biggest side effects I experienced was paranoia,” says Jeremy. Some people may even experience a paranoid

## How Cocaine Interferes with the Brain’s “Reward System”

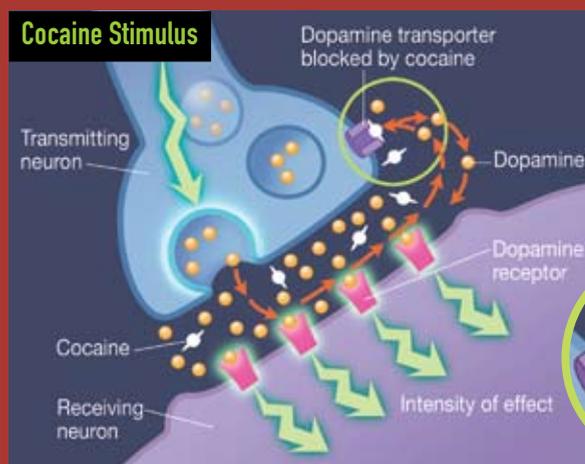
The brain has many different “systems” that control how our bodies function. In the “reward system” the brain chemical dopamine is released, producing feelings of pleasure. By releasing dopamine when you perform activities that you enjoy—like eating a favorite food—your brain is telling you to perform that activity again.

In response to a pleasurable activity, dopamine is sent from a transmitting brain cell, or neuron, to a receiving neuron. Dopamine attaches to a dopamine receptor on the receiving neuron, and sends a signal that tells you that you feel good. Afterward, dopamine detaches from the receiving neuron, and returns to the transmitting neuron through dopamine transporters.

Cocaine interferes with the brain’s reward system by blocking the dopamine transporters, preventing them from taking up the dopamine for recycling. With nowhere to go, the dopamine builds up and reattaches to the receiving neurons, resulting in a magnified feeling of pleasure. With repeated use, the brain requires more and more cocaine to produce this effect. Plus, the brain may no longer release the same amount of dopamine in response to natural rewards.



Dopamine travels between neurons across a gap called the synaptic cleft. It binds to the receptor and sends a signal. Then it detaches and returns to the transmitting neuron through dopamine transporters.



Cocaine blocks dopamine transporters. Dopamine floods the synaptic cleft and reattaches to the receptors, magnifying the pleasurable signal.

psychosis, in which they lose touch with reality and hear voices that are not there.

### Overworking the Body

Stimulants put more than just the brain into overdrive. The effects on the body vary depending on the type of stimulant, how it is taken (orally, snorted, or injected), how much of the drug is taken, and what other substances are used at the same time. Stimulants increase heart rate and blood pressure. They can cause shortness of breath, vomiting, and diarrhea.

Stimulant abuse can also result in death, even after just one use. For example, cocaine constricts the blood vessels, forcing the heart to work harder to keep blood flowing through the body. The heart can work so hard that it temporarily loses its natural rhythm. This condition, called arrhythmia, can lead to a heart attack or stroke.

### Powerfully Addictive

Cocaine and other stimulants are also powerfully addictive. Jeremy found that out the hard way. “The craving became more important than my need for food or sleep,” he says. “It was the most important thing in my life.” As his troubles grew at home and at school, Jeremy felt the urge to use stimulants more. Eventually, Jeremy couldn’t feel happy without the drugs. “I needed the drug to function rather than for fun,” he says. This happens because over time the brain of a stimulant abuser changes. As Dr. Nora Volkow, Director of the National Institute on Drug Abuse (NIDA), explains, “Cocaine abusers often develop

## Where to Find Out More

- For more information on the harmful effects of stimulants and other drugs, visit <http://teens.drugabuse.gov> or [www.scholastic.com/headsup](http://www.scholastic.com/headsup).
- To order additional publications about drugs and your body, call NIDA DrugPubs at **1-877-643-2644** or visit [www.drugabuse.gov](http://www.drugabuse.gov).
- To locate a treatment center, contact **1-800-662-HELP** or visit <http://findtreatment.samhsa.gov>.
- If you need immediate help with a crisis, contact **1-800-273-TALK**.



Photo: © Larry Williams/Flirt Photography/Veer.

**“The craving became more important than my need for food or sleep.”**

a tolerance to the drug, so that they require more and more of the drug to get high. This effect can lead to addiction—the compulsive pursuit and use of the drug, despite devastating consequences.”

### Lasting Harm

Once “hooked,” stimulant abusers put many parts of their bodies at risk. Snorting cocaine or methamphetamine damages the skin on the inside of the nose. It can result in a permanently runny nose, frequent nosebleeds, and loss of the sense of smell. Swallowing certain stimulants can cause bowel gangrene, a condition in which the tissue in a person’s bowels dies due to a lack of blood. People who

inject stimulants run a high risk of contracting blood-borne diseases, such as hepatitis C and HIV, if they share needles.

In the years that Jeremy used drugs, he experienced many physical changes. He had frequent bloody noses and experienced seizures. Addiction also caused his personality to change. “I would do anything—steal, lie, manipulate—to get drugs,” he says. He was arrested multiple times and kicked out of school. He was sent to a juvenile detention center. There, he began treatment that would eventually help him stop using drugs.

Jeremy has been drug free for more than four years, but he still experiences challenges related to his past addiction; he still struggles with cravings when he is stressed. “It never goes away,” he says. Jeremy now knows that, through treatment, recovery is possible. But for some, like him, it can be a long-term process.

**CRITICAL THINKING** 1. What are some reasons that a person might try drugs?  
2. What health risks does drug abuse present that teens might not face otherwise?

## Health Effects of Stimulants

Stimulants are a class of drugs that “stimulate” the body’s central nervous system, which includes the brain and spinal cord. They increase the levels of catecholamines—a family of brain chemicals that includes dopamine. These chemicals are used in the brain processes to signal reward and motivation. By increasing catecholamine levels, stimulants can temporarily increase a person’s energy level and alertness. Stimulants may also cause other changes in the body. The effects vary according to the specific drug, the amount of the drug, and how the drug is taken. For instance, stimulants that are snorted or injected have more immediate effects than drugs that are swallowed.

Stimulants include the caffeine found in coffee, medications such as methylphenidate (Ritalin®, Concerta®), and abused drugs, such as methamphetamine and cocaine. Stimulants can have useful properties—under the right circumstances. For example, doctors use some stimulants to treat disorders such as Attention-Deficit/Hyperactivity Disorder (ADHD). However, when abused, stimulants can pose serious health risks to your brain and your body. Read on to find out the effects of the following stimulants:

- Cocaine
- Prescription stimulants, such as amphetamines and methylphenidate
- Methamphetamine (“meth”)
- MDMA (“ecstasy”)
- Nicotine

### Cocaine

Cocaine, sometimes called “coke” or “blow,” comes in powder or crystal form. It can be snorted, smoked, or injected. Cocaine blocks the dopamine transporter that is responsible for recycling dopamine at the end of a signal between brain cells (called neurons). When this happens, dopamine builds up in the gap between neurons (called the synapse) and overstimulates the neurons. That can cause a powerful, but temporary sense of euphoria.

**Prescribed Use** Cocaine is sometimes used during nose, mouth, or eye surgery, since it constricts blood vessels and helps to control blood flow during the surgery. Cocaine is also a local anesthetic—which means that it can help to numb an area of the body.

#### Health Risks

- Cocaine can speed up heart rate and cause the heart to lose its natural rhythm. In rare cases, this can lead to a heart attack.
- Cocaine constricts blood vessels, which forces the heart to work harder to pump blood.
- Cocaine can cause chest pain and difficulty breathing.
- Cocaine can cause a potentially dangerous increase in body temperature.
- Regularly snorting cocaine can lead to loss of sense of smell, nosebleeds, and problems with swallowing. The overall irritation can lead to a chronically inflamed, runny nose.
- Repeated use or high doses of cocaine can cause irritability, restlessness, panic attacks, and paranoia.

### Prescription Stimulants

Stimulant medications are often prescribed to treat individuals with

Attention-Deficit/Hyperactivity Disorder (ADHD). For example, Adderall® is a brand-name amphetamine medication, and Ritalin® and Concerta® are brand-names for methylphenidate. Like all stimulants, these medications increase dopamine levels in the brain. When used according to a doctor’s orders, the drugs can help a person with ADHD to focus and reduce their ADHD symptoms. However, when taken in high doses, or in ways other than as prescribed (or by someone for whom the drug was not prescribed), stimulant medications can have harmful effects. The effects are similar to other drugs of abuse, and can lead to addiction.

**Prescribed Use** Prescription stimulants can reduce ADHD symptoms and increase focus and attention in people who have ADHD.

#### Health Risks

- Abuse of prescription stimulants can increase heart rate, blood pressure, and body temperature.
- Stimulant medications can decrease sleep and appetite, and abuse can lead to malnutrition and its consequences.

### Methamphetamine

Methamphetamine, often called “meth,” comes in a crystalline powder that can be smoked, snorted, or injected. Like other stimulants, meth increases dopamine levels and can increase energy and cause a temporary feeling of euphoria. However, methamphetamine stays in the body longer than some of the other stimulants, and therefore can have more harmful effects on the central nervous system.

**Prescribed Use** A doctor may prescribe

Continued on page 24



Photo: © Michael Grecco/Uppercut Images/Getty Images.

**THE TRUTH  
ABOUT**

# “REHAB” & DRUG ADDICTION

The reality is far from glamorous

Popular culture is filled with stories about the glitzy lives of celebrities, from the designer clothes they wear to their latest romances. It’s easy to assume that everything they do is glamorous—including going to “rehab.”

“Rehab” is a commonly used term

that can refer to a range of drug treatment options. While some of the centers you see in the news might seem like five-star resorts, there is a big difference: These centers are designed to treat drug and alcohol addiction—which is anything but glamorous. The reality is that it’s a serious disease that

affects the brain and body. Addiction can destroy what people love most—their personal relationships, their careers, and, for some, their lives.

The good news is that, with treatment, people suffering from drug and alcohol addiction can recover and live long, healthy lives.

## What Is Drug Addiction?

People who are addicted to drugs have a compulsive and sometimes uncontrollable craving for them. Using drugs changes the brain. Once addicted, a person wants to use drugs even when he or she faces extremely negative consequences.

That was the case with Edward, 31, who is recovering from drug addiction. Looking back at his teen years, he remembers that his drug addiction led him to miss school, receive bad grades, and get into trouble at home and with the law. He recalls dismissing all of the bad things that happened because of his drug use. “Once I was addicted, nothing could stop me from taking drugs. I saw the negative consequences I faced from taking drugs as obstacles to my [drug] use and lifestyle rather than as a wake-up call,” Edward says.

## Treating a Chronic Disease

Even after successfully completing a drug treatment program, people who are addicted to drugs may relapse. This is because drug addiction is a chronic disease, like asthma or diabetes—it requires long-term treatment to help people get to a point where they can manage their recovery and regain their lives. Also, as with other chronic diseases, patients can relapse. Relapse does not mean that treatment failed—rather it’s a signal that treatment should be started again or modified to make it more effective. The chronic nature of addiction means that people may need treatment or support throughout their lives, and patients often need treatment multiple times to manage the disease.

## Issues With Getting Help

Many people who need treatment for drug or alcohol abuse do not receive it. In 2007, 23.2 million people age 12 or older needed treatment, but only 2.4 million individuals—about 10.3 percent of people in need—actually received treatment for their addiction problems.

Why are some teens and adults not getting the help they need? Some people won’t admit they have a problem. Sometimes people don’t know how to get help. Others know

**“You don’t have to wait until you’ve hit rock bottom to get help. The earlier you get help, the sooner you can begin to recover.”**

they have a problem and how to get help but don’t seek treatment for a range of different reasons.

It is important to get help as soon as there is a problem. As Dr. Nora D. Volkow, Director of the National Institute on Drug Abuse (NIDA), points out, “You don’t have to wait until you’ve hit rock bottom to get help. The earlier you get help, the sooner you can begin to recover.”

## Where Treatment Occurs

Residential treatment centers—places where people live and receive intensive treatment and supervision for varying amounts of time—are just one place to get help. People may

also receive treatment in hospitals and outpatient clinics. Treatment centers may offer multiple types of treatment, including one-on-one behavioral therapy, group therapy and, when available and appropriate, the use of medications.

Once someone decides to get help, it may take time to determine the best

## Overlapping Illnesses

Two illnesses that occur simultaneously are called *comorbid*. Drug addiction is often comorbid with other mental illnesses (addiction is itself a mental illness).

Why is addiction comorbid with other mental illnesses? One reason may be that there are common brain areas involved and possibly even shared genes. Another is that environmental triggers, like stress, that can lead a person to use drugs can also cause mental illnesses, like depression. Similarly, people experiencing the symptoms of a mental illness may turn to drugs or alcohol to cope.

Finally, like drug addiction, other mental illnesses often begin in adolescence, when the brain is undergoing dramatic changes. Using drugs may affect the brain in ways that increase the risk for mental illnesses, including drug addiction, particularly in individuals with genetic or other risk factors.



Photo: © FancyVeer/Corbis.

## Where to Find Help

- If you think you have a drug addiction, talk to your doctor or a trusted friend or adult.
- If you or someone you know is in trouble with drugs, there are treatment centers around the country that can help. To locate a treatment center, visit <http://findtreatment.samhsa.gov> or contact **1-800-662-HELP**.
- If you need immediate help with a crisis, contact **1-800-273-TALK**.
- For more information on the signs and symptoms of using drugs, go to <http://teens.drugabuse.gov> or [www.scholastic.com/headsup](http://www.scholastic.com/headsup).
- To order additional publications about drugs and your body, visit [www.drugabuse.gov](http://www.drugabuse.gov) or call **NIDA DrugPubs** at **1-877-643-2644**.



Photo: © Jim Craigmyle/Corbis.

or cocaine. During this process, a physician may help the person to manage symptoms of withdrawal by administering medications.

Patients also may be able to take medications to help them avoid abusing drugs again. People with an opiate addiction may be prescribed methadone or buprenorphine. Nicotine replacement treatments, such as nicotine gum or the nicotine patch, can help a person addicted to cigarettes quit smoking. Other medications such as naltrexone and disulfiram can help people recover from alcohol addiction.

## Road to Recovery

Even when a variety of treatments are available, relapses may be part of a person's path to recovery from drug addiction. "I was in and out for several years," says Edward. But treatment for drug addiction does work. The most successful treatment addresses each patient's individual drug-abuse patterns and drug-related medical, psychiatric, and social problems. For Edward, becoming willing to accept help from others was the key to long-term recovery. As he explains, "Once I was ready to accept help from other people, I didn't have a relapse. I've been in recovery for seven years now."

### CRITICAL THINKING

1. Drug users often go in and out of treatment centers, or resume taking drugs after being off drugs. Why might this be the case?
2. How are depictions of treatment centers in the media often different than the realities?

treatment program. There is no quick fix for drug addiction. As with other chronic diseases, it often requires long-term, continuous treatment.

## Treatment

Whether at a residential treatment center or an outpatient program, behavioral therapy can play a major role in helping a person manage his or her drug addiction. In one type of behavioral therapy, known as Cognitive Behavioral Therapy, patients come to terms with the harmful consequences of their addiction to drugs. They also learn coping skills for avoiding "triggers" and remaining drug-free.

Avoiding triggers means staying away from things that might cause, or trigger, a person to begin abusing drugs again. As with asthma patients, who avoid dust or smoke to prevent an asthma attack, a person recovering from drug addiction needs to avoid hanging out with friends who abuse drugs and, when possible, avoid extreme stress, which can also trigger a relapse.

Cognitive Behavioral Therapy also can help individuals deal with depression and other mood or anxiety disorders that sometimes go hand in hand with a drug addiction.

For support, people often turn to others in recovery in group therapy settings. People recovering from drug addiction share their experiences and struggles with others facing the same issues.

It was this type of therapy that finally worked for Edward. He received treatment at all types of facilities, including outpatient programs, 28-day and 60–90 day residential drug treatment centers, and a halfway house before he figured out what worked best.

## Medications

Some medications can help patients stop abusing certain types of drugs, stay in treatment, and avoid a relapse. Once a person has decided to begin treatment, the first step is often detoxification: the process that allows a person's body to get rid of a drug such as heroin

Photo: © Flirt Photography/Veer.



## Overlapping Illnesses

**Drug addiction and other mental illnesses, such as depression, often occur in the same person, sometimes at the same time.**

As a teenager, Emily, now age twenty-eight, liked to hang out with friends at the mall, check out the latest movies, and go to concerts. She was also interested in everything that had to do with France. And so when she was selected to participate in a cultural immersion program and travel to France, she jumped at the chance. Emily stayed with a French family. “It was amazing,” she says. But although everything seemed great in Emily’s life, she was very unhappy.

It was during this time that Emily started drinking alcohol and smoking marijuana. “We would drive around and smoke pot with the ‘popular’ boys,” Emily recalls. Though she first tried drugs partly out of curiosity and the desire to try something new, there was another issue involved: Emily was suffering from *depression*, a type of mental illness characterized by prolonged emotional withdrawal and sadness. And one reason she took drugs was to try to cope with her overall sadness.

Although she didn’t realize what was happening at the time, Emily now recalls experiencing symptoms of both her depression and her developing addiction to drugs and alcohol. “I felt so anxious and hopeless much of the time,” Emily says. “It was some strange combination of just feeling drawn to drugs and alcohol, and feeling like I would do anything just to feel better.” Emily first used drugs and alcohol to experience the “high” they provided, but her occasional drug use eventually became an addiction.

Because she now suffered from addiction as well as depression, Emily faced what are called *comorbid conditions*, meaning two separate illnesses that can each affect the other. A person can experience the symptoms of the two illnesses at the same time, at different times, or during periods of time that overlap. Unless a person receives appropriate treatment, comorbid conditions can make the symptoms and outcomes of each illness worse.

Emily’s case is not unique. Approximately six out of ten people with a substance-use disorder also suffer from another mental illness, such as depression, anxiety, or Attention-Deficit/Hyperactivity Disorder (ADHD). (See sidebar graphic on page 20.)

Although comorbid drug addiction

### Why is drug addiction considered a mental illness?

Drug addiction changes the brain in fundamental ways. Drug addiction alters what a person would normally need and desire, and substitutes that with a need and desire to obtain and use drugs. Drug addiction is considered a mental illness because, like other mental illnesses, people are less able to control their thoughts and behaviors—even when faced with many negative consequences.

and other mental illnesses are more common than you might expect, many people don't realize that they may be suffering from two illnesses at the same time. This was certainly the case for Emily. So how does a person know whether they might be vulnerable to comorbid conditions?

### What Are the Risk Factors?

Scientists are beginning to understand some of the risk factors that may cause comorbid

drug addiction and other mental illnesses. These include:

**Genes:** Just like certain genes determine your eye color, scientists think there are genes that could *predispose* (i.e., increase the risk for) a person to drug addiction, other mental disorders, or both. On the other hand, certain genes can protect a person from addiction and other mental disorders.

**Environment:** Genes alone can't

cause a person to become addicted to drugs. The environment that you live in (i.e., your family, friends, neighborhood) can affect your risk for drug addiction. Exposure to drugs, stress, or trauma (including physical or sexual abuse), as well as peer influence and family stability, are other factors that can influence whether or not a person abuses drugs and whether he or she is likely to become addicted. Some of these same factors can also affect a person's risk for mental disorders, such as depression or anxiety.

**Age:** Being a teenager is tough enough with growth spurts, acne, and peer pressure. But that's not all some teens have to deal with. Drug abuse and other mental illnesses often begin during the teen years. This is a time when teens become more independent, but they also become more likely to take risks, some of which may be unhealthy. One reason for teen risk-taking is that the area of the brain responsible for judgment and decision-making, called the prefrontal cortex, is not yet fully developed.

**Effects of drugs and mental illness on the brain:** Both drugs and other mental disorders can affect similar regions of the brain and similar brain chemicals. Because of this, drugs can cause changes to the brain that affect the likelihood of a person developing another mental illness. Likewise, having a mental disorder could affect brain functions in a way that increases a person's vulnerability to abusing drugs and/or alcohol.



### How often do people with substance use disorders also suffer from another mental illness?

People with substance use disorders may also suffer from mood or anxiety disorders at some point in their lives. In fact, for every ten people with a substance use disorder, six of those ten people also have another mental illness.

The photographs above represent ten people who suffer from a substance use disorder. The photographs with black numbers show the people out of this group who also suffer from another mental illness.

Left to right, top row: © RubberBall Productions; © Hill Street Studios/Blend Images/Getty Images; © RubberBall/Getty Images; © Media Bakery; © RubberBall Productions. Left to right, bottom row: © LVA/Stephen Weisstead/Blend Images/Getty Images; © RubberBall Productions; © Silva/Photodisc/Getty Images; © Media Bakery; © Stockbyte/Getty Images.

## What Other Mental Illnesses Commonly Occur with Drug Addiction?

Some mental illnesses that commonly occur with drug addiction include:

**Depression:** Depression is a mental illness characterized by prolonged emotional withdrawal and sadness.

**Bipolar disorder:** Bipolar disorder is a mental illness characterized by dramatic mood swings from feeling overly “high” and/or irritable to feeling sad and hopeless, and then back again, often with periods of normal mood in between.

**Attention-Deficit/Hyperactivity Disorder (ADHD):** When a person has ADHD, he or she has difficulty paying attention, keeping still, and controlling impulsive behaviors. Children with untreated ADHD are at a high risk of abusing drugs and alcohol, which could lead to drug addiction.

## What Is the Treatment?

When a person has both drug addiction and another mental illness, treatment should target both disorders. Research has shown that, when available, a combination of medications and behavioral therapy works best for individuals who suffer from comorbid drug addiction and other mental illnesses. (*Behavioral therapies* can teach people to cope with stress and avoid situations and people that lead to drug use.) But treatment will always depend

on the individual and the types of illnesses involved.

Scientists are making steady progress on treatments for comorbid conditions through ongoing tests of new and existing treatments in various settings. For example, one therapy that shows promise is called Multisystemic Therapy (MST). MST targets key factors associated with drug use, such as attitudes, family, peer pressure, school, and neighborhood culture. Another treatment, called Brief Strategic Family Therapy (BSFT), addresses family interactions that may affect drug abuse or other behavioral problems in the family.

## Emily’s Recovery

Luckily, Emily got help for both her drug addiction and depression. Her recovery has involved treatment for both. In 2003, through group therapy sessions, Emily was able to stop abusing drugs and drinking alcohol. “[Group therapy] changed my life pretty quickly. I went every single day and had so much help and support,” Emily says. She also got one-on-one help from a therapist and took medications prescribed by a doctor to manage the symptoms of her depression and anxiety.

Emily feels that addressing her drug addiction also helps her to manage her other mental illnesses. “My treatment for addiction has absolutely helped my anxiety and depression,” Emily explains. “You learn how to cope with life and anxiety.”

Emily has been recovering over several years and her hard work has paid off. Her life is changing for the better. She finished graduate school with flying colors. In addition, her social life took off. “I formed amazing relationships, and today I have so many friends that I can’t believe it,” Emily says. “I secretly felt so socially unacceptable my whole life, so I can’t believe how lucky I am today.”

## Where to find help

- If you think you have a drug addiction or another mental illness, talk to your doctor or a trusted friend or adult.
- If you or someone you know is in trouble with drugs, there are treatment centers around the country that can help. To locate a treatment center, visit <http://findtreatment.samhsa.gov> or contact 1-800-662-HELP.
- If you need immediate help with a crisis, contact 1-800-273-TALK.
- To locate mental health services, visit [www.nimh.nih.gov/health/topics/getting-help-locate-services/index.shtml](http://www.nimh.nih.gov/health/topics/getting-help-locate-services/index.shtml).
- To order additional publications about drugs and your body, visit [www.drugabuse.gov](http://www.drugabuse.gov) or call NIDA DrugPubs at 1-877-643-2644.
- For more information on the signs and symptoms of using drugs, go to <http://teens.drugabuse.gov> or [www.scholastic.com/headsup](http://www.scholastic.com/headsup).

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“Do You Know Your Risk for Addiction?”

**Gender.** Studies show differences in the way drugs affect male and female bodies, as well as how and why men and women use drugs. For example, women are more likely than men to become addicted to drugs designed to treat anxiety or sleeplessness, while men are more likely than women to abuse alcohol and marijuana. In the past, studies showed that, overall, there was a higher rate of drug use and addiction among men than among women. However, in recent years, this gender gap is closing—current studies show that equal numbers of male and female teens are reporting that they are using drugs. The consequences of this shifting pattern remain to be seen.

**Ethnicity.** Ethnicity is a factor that has both biological and environmental components. For instance, some ethnic groups show different rates of metabolism of drugs (how drugs are broken down by the body), which can affect drug sensitivity. But there are also cultural factors that influence drug use, and societal factors that impact the consequences of drug use. For example, while overall drug use by African-Americans and Hispanics is lower compared to white Americans, the consequences—such as trouble with the law or risk for disease such as HIV/AIDS—disproportionately affect minorities.

## Environmental Factors

Environmental factors are related to a person’s surroundings and the influences he or she lives with. Environmental factors that can contribute to someone’s risk for drug abuse and addiction include:

**Home and family.** The home environment

has an important impact on a person’s risk for drug abuse and addiction. Teens are at greater risk if they live in chaotic homes where there is little parental or adult supervision. This type of home environment can be the result of parents or older family members who suffer from a mental disorder, engage in criminal behavior, or abuse drugs or alcohol. On the other hand, a nurturing home environment, as well as clear rules of conduct at home, can be protective factors that reduce the potential for drug abuse.

**Availability of drugs.** Research has clearly shown that the availability of drugs in a person’s home, school, or community is one of the key risk factors for a person developing drug problems. For example, the abuse of prescription drugs, which has been on the rise for the last several years, is occurring at the same time as a sharp rise in medical prescriptions. This increased availability, combined with a lack of understanding about the dangers of misusing prescription drugs, affects the risk of addiction.

**Social and other stressors.** Stress, and particularly early exposure to stress, is linked to early drug use and later drug problems. For example, stressors such as physical or sexual abuse, or witnessing violence, may contribute to someone’s risk of addiction. In addition, poverty is often linked to stress, and to chaotic lifestyles, which may increase the risk of drug abuse. In contrast, involvement in social networks that are supportive, and where disapproval of drug use is the norm, can protect against drug use.

These groups might be sports teams, religious groups, or community groups. **Peer influence.** Associating with peers who engage in risky behaviors and who

## What is drug addiction?

Addiction is defined as a chronic and relapsing, yet treatable, brain disease characterized by compulsive drug seeking and use, despite negative or harmful consequences. Drug addiction is considered a brain disease because drugs change the structure of the brain, as well as how the brain works. It is similar to other diseases, such as heart disease, in that it disrupts the normal, healthy functioning of the organ (the brain). Like other diseases, drug addiction can have serious harmful consequences, but it is also preventable and treatable.

## How do drugs affect the brain?

Drugs are chemicals that interfere with the way nerve cells normally communicate in the brain. All drugs target the brain’s reward system by increasing the release of dopamine, a chemical linked to pleasurable experiences, such as eating. The excess dopamine produces the “high” that makes a person feel good and teaches him or her to repeat the behavior. Over time, the brain adjusts to the excess dopamine, and the person can no longer experience pleasure in normal ways—they need the drug to feel good. Other parts of the brain become involved as well, including those associated with memory and self-control. Eventually, nothing else can compete with the drug experience. Food, family, and friends lose their former value, while the need to seek and use drugs becomes all-consuming—this is the essence of addiction.

use drugs is another key risk factor, especially for teens. Choosing friends who do not use drugs can protect a person from drug abuse and addiction.

**School performance.** Academic failure may be a sign that a teen is currently abusing drugs and is in need of intervention, or it may be a risk factor for later drug abuse. On the other hand, teens who are successful in school, have positive self-esteem, and develop close bonds with adults outside their families (such as teachers) are less likely to abuse drugs.

Continued from page 11  
*"In Their Own Words: Teen Science-Investigators"*

**Heads Up:** What are your favorite hobbies?

**Shelby:** Shopping, cross-country running, hanging out with my friends, and community service.

**Heads Up:** What's your dream job?

**Shelby:** Spokeswoman for a teen magazine.

**Heads Up:** What sparked your interest in studying addiction?

**Shelby:** I didn't study addiction specifically, but addiction is quite an obvious problem we are having today, so it is definitely an issue that is interesting to look into.

**Heads Up:** What inspired you to tackle your particular topic?

**Shelby:** My topic was something that I was really interested in finding out the results for. I was just thinking one day about what makes a good friend and the word "cool" came to mind; so that got me interested in what a "cool" teenager really is.

**Heads Up:** What finding most surprised you?

**Shelby:** I was quite surprised to find out that 17-year-olds thought it was cooler to drink alcohol, smoke, and take part in risky behaviors than any other age group (among 14-, 15-, 16-, and 18-year-olds). This was the same age group that rated themselves as being the coolest [in comparison with other ages].

**Heads Up:** What was the hardest part about the project?

**Shelby:** The most difficult part about the project was analyzing the data

(figuring out the findings) because statistics get really confusing. That's where you definitely need a mentor.

**Heads Up:** Any future plans to study science?

**Shelby:** I'm hoping to go to ISEF 2009, but I still need to think of a cool science project idea to get me started. I will also be studying a lot of science in 10th grade this year: physics, chemistry, and psychology.

**Heads Up:** Why do you think addiction science is important?

**Shelby:** Just from the people around me, I know friends' parents who are addicted to alcohol and smoking, and teens at my high school who are already addicted to various drugs. Being addicted to anything doesn't usually have positive outcomes, so it is important that researchers understand the reasons behind addiction and how it can possibly be controlled.

**Heads Up:** Why do you think it's important for teens to understand the science behind drug addiction?

**Shelby:** I believe teens really need to understand the science behind drug addiction because it might make them realize how harmful and dangerous getting into drugs really can be. If teens don't understand the science behind drug addiction, then they continue to nonchalantly use drugs just for a fun time and don't connect the true effects that drugs [can have].

**Heads Up:** What do you think a teen perspective brings to the study of science versus an adult perspective?

**Shelby:** Teens aren't interested in the same things as adults, so teens are likely to explore an issue differently than adults would.

**Heads Up:** How do you think science and scientific research has helped other parts of your life?

**Shelby:** Doing the science project has definitely helped me realize that I can have joy in learning. Taking part in the science fair led me to realize that I can succeed at anything I can dream of as long as I put a lot of effort and heart into it.

**Heads Up:** What would you say to other students to inspire them to participate in ISEF 2009?

**Shelby:** ISEF really opened my eyes to the world around me. There were teenagers at ISEF from over 40 different countries who spoke all different languages, which gave me a taste of how much diversity there really is. It is also amazing to see how much ambition all the participants have to learn and to achieve. It proves to you that there will be amazing scientists to come in the future. Although judging time is rough, talking to the judges helped me to better explain and present any ideas I have.

**Heads Up:** How do you plan to spend your prize money?

**Shelby:** I plan on putting the money in my bank account to use for college.

For more information about the NIDA-Scholastic *Addiction Science Awards*, addiction science topics, and how to enter next year's *Addiction Science Award* competition, visit [www.drugabuse.gov/sciencefair](http://www.drugabuse.gov/sciencefair).

Continued from page 15  
“Health Effects of Stimulants”

methamphetamine in low doses to treat ADHD or narcolepsy, a disorder in which a person experiences extreme sleepiness during the day and may fall asleep uncontrollably. However, due to the many serious harmful effects of methamphetamine, and the availability of other medications with lower risk, doctors rarely prescribe methamphetamine.

### Health Risks

- Methamphetamine can cause rapid or irregular heartbeat and increased blood pressure. These effects can lead to a heart attack.
- Methamphetamine can increase body temperature. In rare cases, hyperthermia can lead to liver, kidney, and cardiovascular failure and death.
- Methamphetamine can cause the gums to decay and the teeth to rot, a condition known as “meth mouth.”
- Long-term use of methamphetamine can cause changes to the structure of the brain in areas involved with memory and emotions. This can lead to memory problems and erratic behavior.
- Long-term use of methamphetamine can cause paranoia, hallucinations, and violent behavior.

## MDMA

MDMA, or “ecstasy,” comes in the form of a pill. In addition to affecting dopamine levels in the brain, MDMA affects the nerve cells in the brain that use the chemical serotonin to communicate with other nerve cells. Like other stimulants, the effects of MDMA can include increased energy and feelings of well-being.

**Prescribed Use** No medical uses.

### Health Risks

- MDMA can increase heart rate and blood pressure.
- MDMA can increase body temperature. In rare cases, this can lead to liver, kidney, and cardiovascular failure and death.
- MDMA can cause muscle tension and involuntary teeth clenching.
- Repeated MDMA use can disrupt sleep, memory, and mood (at least temporarily).

## Nicotine

Nicotine is a highly addictive stimulant found in cigarettes and chewing tobacco. Like other stimulants, nicotine increases dopamine in the brain. It also stimulates the body’s adrenal glands to release epinephrine (also called adrenaline). Epinephrine is normally released when a person experiences a stressful situation. Epinephrine stimulates the central nervous system, increasing heart rate, breathing rate, and blood pressure.

**Prescribed Use** Medicinal nicotine in the form of a patch or gum is used to help people stop smoking and using other tobacco products. The nicotine in these products helps reduce the person’s withdrawal symptoms.

### Health Risks

- Nicotine increases heart rate and blood pressure.
- Nicotine increases blood sugar levels.
- Chewing or smoking tobacco discolors teeth and causes tooth decay.
- Chewing or smoking tobacco can cause cancer of the lungs, mouth, and throat.

## Getting Help

If you or someone you know is abusing

or addicted to stimulants, there are many drug treatment programs and support groups that can help. Currently behavioral therapies are the most effective approach to treating stimulant addiction. Treatment programs seek to engage people in therapy, reward abstinence, and/or to help change the way a drug user thinks and behaves when faced with situations that may lead to drug use.

With the exception of nicotine (tobacco addiction), there are no medications approved to treat stimulant addiction. However, scientists are actively working in this area. They are studying different types of medications to help prevent cravings, reduce relapse, and address some of the mood and other problems that people addicted to stimulants often have. Scientists believe that a combination of medications (when they become available) and behavioral therapies will likely prove to be the most effective approach to treating stimulant addiction in the future.

For more facts about stimulants and other drugs, visit <http://teens.drugabuse.gov/facts>.

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