



HEADS UP REAL NEWS ABOUT DRUGS AND YOUR BODY

In This Installment

- * Why methamphetamine is a threatening scourge
- * How methamphetamine alters abusers' brains
- * Toxic threats of chemicals used to manufacture methamphetamine
- * Why teens need know the facts about methamphetamine
- * Addiction to methamphetamine is a treatable disease

Coming Up in the Next Installment

Dangers of Inhalants

Assessment Quiz

Use the Activity 1 Reproducible within as an Assessment Quiz to determine your students' core base of knowledge and to test what they've learned about drug abuse, addiction, and disease.

To order additional free copies of this Heads Up Teacher Edition, call 800-729-6686 and refer to NCADI MS983. For the accompanying Student Edition, refer to NCADI MS982.

Methamphetamine: A Threatening Scourge on Teens, Families, and Communities

Dear Teacher:

The National Institute on Drug Abuse (NIDA) and Scholastic Inc. are dedicated to bringing students clear, science-based information about drugs and addiction. We are passionate about this mission because research has shown that when young people are armed with facts, they are more likely to make smart choices about their health and their futures.

For those reasons, we are launching the fourth edition of *Heads Up: Real News About Drugs and Your Body*. Over the course of this school year, we will bring you a series of articles about drugs of abuse that NIDA researchers have determined to be of greatest risk to the teen community.

In this first installment of the series, we cover the scourge of methamphetamine, a devastating, addictive stimulant that can be snorted, swallowed, injected, or smoked, and which is increasingly available across the United States. We want to make sure that students

understand the devastating effects of methamphetamine and how it poses serious health risks not only to individuals who use it but also to others who never do. We want them to also know the risks from the highly toxic chemicals that are used to make methamphetamine. Armed with these facts, they can make smart choices if ever faced with this drug.

Together with our partners, including classroom teachers like you, we at NIDA are working toward a day when young people everywhere understand the risks of drugs and the damage they can cause. Thank you for helping us come closer to that time, a time when every student in the U.S. will know that trying drugs is always the wrong choice.

Sincerely,

Nora D. Volkow, M.D.
Director of NIDA



For printable past and current articles in the **HEADS UP** series, as well as activities and teaching support, go to www.drugabuse.gov/parent-teacher.html or www.scholastic.com/HEADSUP.

Lesson Plans for Student Activities

PREPARATION: Before beginning the lessons, make these photocopies: Two copies for each student of Activity 1 Reproducible “Heads Up: Methamphetamine—A Quiz” (page 3) to be used as a pre-text and post-text quiz, and one copy for each student of Activity 2 Reproducible “Heads Up: What Methamphetamine Does to Your Brain” (page 4).

Lesson 1 Heads Up: What Do You Know About the Dangers of Methamphetamine?

OBJECTIVE

To give students science-based facts about methamphetamine; to educate students about the ways in which methamphetamine can damage the brain and immune system; to help students understand that trying methamphetamine even once can be hazardous; and to assess students’ knowledge of the topics before and after reading the article.

NATIONAL SCIENCE EDUCATION STANDARDS

Life Science; Science in Personal and Social Perspective

LESSON STRATEGY

Introducing the Topic

- Before the lesson begins, hold a class discussion based on these questions: What is methamphetamine? What do you know about it and how it affects the body and brain? What is the source of your information? How can you determine if your source is reliable?

- Tell students that they are going to see how much they know about methamphetamine and what the latest research is teaching us about it. Distribute copies of Activity 1 Reproducible. Tell students to write their names on the paper and label it No. 1. Then have them answer the questions. Collect and grade the papers.

READING, DISCUSSION, AND ASSESSMENT

- Have students read the article “Methamphetamine: Toxic. Addictive. Devastating. Get the Facts!” Next, hold a discussion based on these questions: Why is it especially important today that teens understand the risks of using methamphetamine? What are the risks to users? To nonusers? What happens in the brain when a person takes methamphetamine? What does the article mean when it says that methamphetamine “tricks” the brain into releasing high and unnatural

levels of dopamine? What are the dangers of the chemicals used to illegally make methamphetamine?

- Next, tell students it’s time to see how much they’ve increased their knowledge. Give them a second copy of Activity 1 Reproducible. Tell them to write their names on the paper and label it No. 2. When students have finished, collect the papers, score them, and compare the results before and after the lesson.

WRAP-UP

- Conclude the lesson by asking students whether they think young people and adults in their community understand the risks of methamphetamine. Have students brainstorm ways of getting these messages across. If possible, put some of the best suggestions into action.

ANSWERS TO REPRODUCIBLE QUIZ ON PAGE 3:

1. b; 2. d; 3. c; 4. a; 5. d; 6. b; 7. a; 8. a; 9. d; 10. a.

Lesson 2 Heads Up: What Methamphetamine Does to Your Brain

OBJECTIVE

Students use scientific data to draw conclusions about the effects of methamphetamine on brain chemistry, memory, and motor skills.

NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry; Science in Personal and Social Perspective

LESSON STRATEGY

Introducing the Topic

- Tell students that new advances in imaging are allowing scientists to study the living brain to understand how drugs affect its structure and chemistry. Ask students how they think this capability has changed research, and how it can work with other types of inquiry to increase our understanding of drugs and the harm they can cause.
- Explain to students that they are going to read about an experiment in which researchers used positron emission tomography (PET), a

noninvasive imaging technique, to compare dopamine transporter (DAT) levels in the brains of methamphetamine abusers with those in non-drug users. (Methamphetamine produces pleasure by releasing extra dopamine in the brain.) The study subjects were also given memory and motor skill tests, because the researchers wanted to see if there was a relationship between DAT levels and performance on these tests.

- Ask students why they think it’s important to learn about how particular drugs affect the brain. How is this information useful to scientists who study addiction? To teenagers?

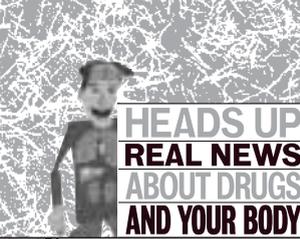
READING, DISCUSSION, AND WRAP-UP

- Hand out Activity 2 Reproducible. Have students read the sheet and answer the questions at the end.
- Wrap up the lesson by discussing the following questions: Could spreading

the news about how dramatically methamphetamine affects brain structure, memory skills, and motor skills help cut down the number of new users? Why or why not? What kinds of follow-up experiments would you conduct if you were on the research team? How could you set up an experiment to see whether the brain changes you detected are permanent?

ANSWERS TO REPRODUCIBLE QUESTIONS ON PAGE 4:

1. Dopamine is a brain chemical that plays a key role in motor activity, motivation, and feelings of pleasure. DATs move dopamine around in the brain. 2. They knew animals given high doses of methamphetamine had lowered DAT levels and wanted to see if the doses of methamphetamine abused by humans also resulted in lowered DAT levels; they suspected the loss of DATs might affect motor skills and memory because of the location in the brain where DAT levels were most reduced. 3. By using PET scans. 4. DAT reductions probably result in decreases in motor and memory skills; methamphetamine abuse can result in lower DAT levels. 5. Athlete: using the drug may reduce chances of success by impairing motor skills. Lawyer: using the drug may reduce chances of success by impairing memory skills.



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Heads Up: Methamphetamine—A Quiz

Test your knowledge of the drug methamphetamine by answering the questions below.

1. Methamphetamine is a

- a. hallucinogen.
- b. stimulant.
- c. narcotic.
- d. painkiller.

2. Which of the following does methamphetamine affect?

- a. the brain
- b. the body's immune system
- c. the environment
- d. all of the above

3. Dopamine is a brain chemical most important in regulating feelings of

- a. anger.
- b. jealousy.
- c. pleasure.
- d. déjà vu.

4. At first, methamphetamine causes

- a. an unnaturally high level of dopamine in the brain.
- b. a shortage of dopamine in the brain.
- c. the destruction of all dopamine in the brain.
- d. the destruction of some dopamine in the brain.

5. Methamphetamine can be responsible for

- a. violent behavior.
- b. burns.
- c. explosions.
- d. all of the above.

6. When methamphetamine abusers try to quit, they often experience

- a. euphoria.
- b. a lack of pleasure.
- c. extreme violent impulses.
- d. amnesia.

7. Methamphetamine can cause the body to heat up excessively, which can lead to

- a. convulsions.
- b. lung cancer.
- c. heart attack.
- d. brain tumor.

8. Methamphetamine causes alterations in the areas of the brain responsible for

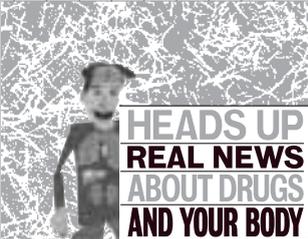
- a. memory and motor skills.
- b. breathing.
- c. sleep regulation.
- d. all of the above.

9. Which of the following technologies did scientists use to determine that methamphetamine abuse results in brain alterations?

- a. X rays
- b. CAT scan (Computerized Axial Tomography)
- c. centrifuge
- d. Magnetic Resonance Imagery (MRI)

10. Methamphetamine addiction is a disease that

- a. can be treated with behavioral therapy.
- b. is incurable.
- c. can be easily cured with medication.
- d. is contagious.



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Heads Up: What Methamphetamine Does to Your Brain

With methamphetamine blazing a destructive path across the country, it has become urgent for young people to understand how the drug affects the brain. The NIDA-sponsored experiment described below does exactly that. The results are dramatic.

The Experiment: Dopamine Transporters, Methamphetamine, and Memory and Motor Problems

Background In 2000, when this experiment was conducted, scientists knew that animals given high doses of methamphetamine wound up with fewer dopamine nerve transporters, or terminals, in their brains. Dopamine is a brain chemical important for pleasure, motivation, and motor activity. Dopamine transporters, or DATs, are located on the dopamine terminal and are responsible for recycling dopamine back into the neuron that released it. This is a necessary step for proper communication between nerve cells.

Scientists can attach a radioactive compound to

DATs in humans. Then, using imaging techniques, they can measure changes in the number of dopamine transporters to find out whether methamphetamine abusers have fewer dopamine transporters (and presumably fewer dopamine terminals) than nonusers.

This experiment was designed to determine not only whether methamphetamine abuse reduced DATs, but also whether changes in DATs could be linked to changes in abusers' behavior and performance. Problems with memory and motor skills have been associated with methamphetamine abuse, and these are both activities that involve dopamine.

Description Scientists attached radioactively labeled compounds to the DATs in the brains of 15 long-term methamphetamine abusers and 18 non-drug users. Then their brains were scanned using PET (positron emission tomography), which enabled scientists to see and measure DATs. The participants were then given four tests to assess their motor and memory abilities:

- **Timed Gait Test:** Walking a straight line as quickly as possible.
- **Grooved Pegboard Test:** Putting pegs into small, angled holes as quickly as possible.
- **Interference Recall Test:** Learning and recalling words after a distraction.
- **Delayed Recall Test:** Learning and recalling words after a delay.

Results When the experiment was complete, the researchers analyzed the results. They compared the test scores and DAT levels of methamphetamine abusers with those of the non-drug users. This is what they found:

DAT Levels The methamphetamine abusers, who had abstained from drug abuse for at least 2 weeks, all had fewer DATs than the non-drug users. The difference was most dramatic in the striatum, a part of the brain

associated with motivation, attention, and control of movement, and was evident even in a former methamphetamine abuser who had abstained for 11 months.

Test Performance The researchers found that lower DAT levels corresponded to worse performance on all four motor and memory tests described above. The subjects with the lowest DAT levels performed worst on the tests.

You're the Scientist Now imagine that you're a scientist analyzing the data from this experiment, and answer these questions. Write your answers on the back of this page.

Understand

1. What is dopamine? What does a dopamine transporter (DAT) do?

2. Why were researchers interested in DAT levels in methamphetamine abusers? Why did they suspect a link between DAT levels and motor and memory skills?

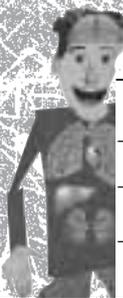
3. How can you measure DAT levels in a human brain?

Analyze

4. What conclusion can you draw from the fact that the lower a methamphetamine abuser's DAT level, the lower his/her performance on the motor and memory tests? What does this tell you

about how methamphetamine affects the brain?

5. Based on the experiment results, how would you predict methamphetamine abuse might affect the future career success of a teen who wanted to be a professional athlete? What about a teen who wanted to be a trial lawyer?



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Inhalants: A Looming Threat for All Teens



—A message from Dr. Nora D. Volkow,
Director of NIDA

Dear Teacher:

I have an important warning to share with you. Some of the most dangerous substances abused by your students may be found in the home—and even in schools. As a group, these toxic substances are referred to as inhalants. They are breathable chemical vapors that produce mind-altering effects. Abusers breathe in toxic fumes to achieve a high. Substances that are abused as inhalants include computer cleaner, nail polish remover, glue, and a host of other products that may seem

abusing inhalants once or twice was risky.

Monitoring the Future and other studies indicate that inhalant abuse is particularly prevalent among young teens. Some may abuse inhalants as a substitute for alcohol because they can be obtained easily.

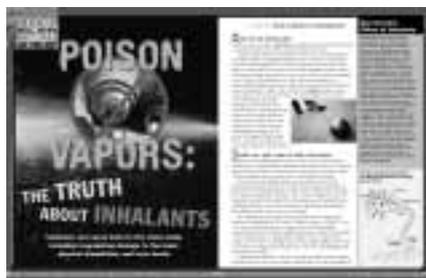
This article, the second installment in this year's edition of *Heads Up: Real News About Drugs and Your Body*, will alert your students to the real dangers of inhalant abuse and explain to them why the smart choice is never to try inhalants—not even once.

In addition to sharing this article with your classes, there is one other step you can take to keep your students safe from inhalants. Encourage school officials and parents to store household products carefully; they should be keenly aware of the temptations that these dangerous substances pose to young people (as well as the danger of accidental inhalation by very young children).

Thank you for devoting a portion of your valuable classroom time to sharing this key message about inhalants with your students. As ever, we deeply appreciate your willingness to play a vital role in NIDA's mission: helping young people everywhere understand the risks of drugs and the damage they can cause.

Sincerely,

Nora D. Volkow, M.D.
Director of NIDA



harmless because their intoxicating effects are so totally unconnected to their intended uses.

Inhalants are anything *but* harmless. They are dangerous poisons that can kill in an instant. And I am troubled to report that the use of inhalants is on the upswing among young people—bucking the overall trend of decreasing drug abuse among teens. NIDA's most recent Monitoring the Future study, an annual survey of youth drug abuse, found a significant increase in the number of 8th-graders saying they had tried inhalants at least once. Not only that: more than 66 percent of students in this age group didn't think that

In This Installment

- How all inhalants are poisonous chemical vapors.
- How inhalants can cause a condition called **sudden sniffing death**.
- How inhalants can cause damage to the whole body—including death.
- Why teens need to learn the facts.

Coming Up in the Next Installment

- Dangers of Prescription Drug Abuse

Assessment Quiz

Use the Activity 1 Reproducible within as an Assessment Quiz to determine your students' core base of knowledge and to test what they've learned about inhalants.

For printable past and current articles in the **HEADS UP** series, as well as activities and teaching support, go to www.drugabuse.gov/parent-teacher.html or www.scholastic.com/HEADSUP.

Lesson Plans for Student Activities

PREPARATION: Before beginning the lessons, make these photocopies: Two copies for each student of Activity 1 Reproducible “Heads Up: Inhalants—A Quiz” (page 7) for a pre-reading and post-reading quiz, and one copy for each student of Activity 2 Reproducible “Heads Up: Learning How Inhalants Become Drugs of Addiction” (page 8).

Lesson 1 Heads Up: What Do You Know About Inhalants and Their Dangers?

OBJECTIVE

To give students science-based facts about inhalants; to educate students about the ways in which inhalants can damage the brain and body, sometimes causing death; to help students understand that trying inhalants even once can be dangerous or even deadly; and to assess students’ knowledge of the topics before and after reading the article “Poison Vapors: The Truth About Inhalants.”

NATIONAL SCIENCE EDUCATION STANDARDS

Life Science; Science in Personal and Social Perspective

LESSON STRATEGY

Introducing the Topic

- Before the lesson begins, hold a class discussion based on these questions: *What are inhalants? How can they damage the body and brain? Surveys show that some teens think inhalants are less dangerous than they really are. Why might that be?*

- Tell students that they are going to find out how much they know about inhalants and what the latest research is teaching us about them. Distribute copies of Activity 1 Reproducible. Tell students to write their names on the paper and label it No. 1. Then have them answer the questions. Collect and grade the papers.

READING, DISCUSSION, AND ASSESSMENT

- Have students read the article “Poison Vapors: The Truth About Inhalants.” Next, hold a discussion based on these questions: *What are the key dangers of inhalant abuse? Why do you think many young teens don’t understand the risks of inhalants? Does the fact that many inhalants have innocent purposes, such as cleaning, make them seem less dangerous?*
- Next, tell students it’s time to find out how much they’ve increased their knowledge. Give them a

second copy of Activity 1 Reproducible. Tell them to write their names on the paper and label it No. 2. When students have finished, collect the papers, score them, and compare the results. Share the results with students before and after the lesson.

WRAP-UP

- Conclude the lesson by asking students what they think might be the most effective way to inform young people about the dangers of inhalants. Ask them if they think products that are abused as inhalants should carry warning labels, or if it should be against the law to sell products like computer cleaner to young people. Brainstorm ways that your class could spread the word about the risks of abusing inhalants.

ANSWERS TO REPRODUCIBLE QUIZ ON PAGE 7:

1. b; 2. b; 3. b; 4. d; 5. d; 6. d; 7. a; 8. c; 9. a; 10. c.

Lesson 2 Heads Up: Learning How Inhalants Become Drugs of Addiction

OBJECTIVE

Students use scientific data to draw conclusions about the effects of toluene (a toxic component of many inhalants) on brain chemistry, behavior, and motor activity; students learn that the chemicals in inhalant vapors can lead to addiction.

NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry; Science in Personal and Social Perspective

LESSON STRATEGY

Introducing the Topic

- Begin by sharing with students the definition below of **drug addiction**, taken from the article “Drug Addiction Is a Disease: Why the Teen Brain Is Vulnerable,” www.scholastic.com/headsup. (You may want to provide this entire article to students as back-up.)

Drug addiction: A chronic relapsing disease that is characterized by compulsive drug-seeking and abuse and long-lasting chemical changes in the brain.

Based on what they’ve already

learned about inhalants from the article, ask students the following: *Why do you think inhalants can be classified as a drug of addiction?*

- Next, explain that students are going to read about an experiment in which researchers tested rats to find out how their brains and bodies respond to an inhalant component called toluene. (The experiment is described in Activity 2 Reproducible.) If the brain and body respond in the same way that they do to many other drugs of abuse, this will show that toluene may cause addictive behavior in a similar way. The brain chemical tested in the experiment was dopamine because of its key involvement in feelings of pleasure and motivation, as well as in motor coordination. *Ask students why and how they think drugs are able to change the way people behave. How do inhalants affect abusers’ behavior?*

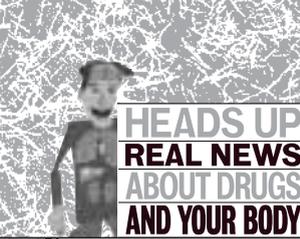
READING, DISCUSSION, AND WRAP-UP

- Hand out Activity 2 Reproducible. Have students read the sheet and answer the questions at the end.
- Wrap up the lesson by discussing the

following questions: *How does the flood of dopamine in the brain that toluene apparently causes seem to affect the behavior of individual people who abuse inhalants? Based on this experiment, what might happen to toluene abusers’ behavior if you gave them a drug that blocked dopamine from getting to the NAc? What would you need to know before you could recommend such treatment?*

ANSWERS TO REPRODUCIBLE QUESTIONS ON PAGE 8:

1. Question part one: Dopamine acts on the brain to allow people to feel pleasure and motivation, and helps control motor coordination. **Question part two:** Taking drugs that make the brain produce unnaturally high levels of dopamine can throw off the brain’s own ability to produce it. Abusers may then become addicted and unable to experience pleasure without the drug. **2.** Scientists knew amphetamine caused roaming by flooding the NAc with dopamine. They knew that scopolamine caused similar behavior through a different mechanism. They wanted to compare toluene—which they knew caused roaming—to see which category it fell into. **3. Question part one:** That inhalants may change abusers’ brains so that the only way to feel pleasure is to continue inhaling. **Question part two:** Scientists can figure out ways to restore brain chemistry to normal.

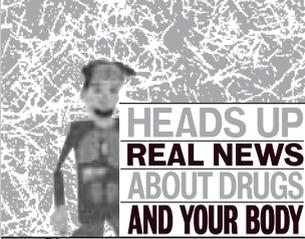


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Heads Up: Inhalants—A Quiz

Test your knowledge of inhalants. Choose the correct answer to each question.

1. **Most inhalants are actually intended to be**
 - a. prescription drugs.
 - b. household and office products.
 - c. painkillers.
 - d. cold medicine.
2. **How do inhalants wind up in abusers' bloodstreams?**
 - a. Abusers inject them.
 - b. Abusers breathe them in.
 - c. Abusers take them in pill form.
 - d. All of the above.
3. **Some inhalants are safer than others.**
 - a. true
 - b. false
4. **Which of the following organs or body systems can be seriously damaged by inhalant abuse?**
 - a. the nervous system (brain, spinal cord, and nerves)
 - b. the heart
 - c. the liver
 - d. all of the above
5. **The inhalant nitrous oxide can rob the body of _____, causing death.**
 - a. blood
 - b. essential vitamins
 - c. dopamine
 - d. oxygen
6. **Which of the following is not a risk of inhalant abuse?**
 - a. hearing loss
 - b. blackouts
 - c. sudden sniffing death
 - d. none of the above
7. **Toluene, a chemical found in many inhalants, can cause muscle spasms, tremors, and hearing loss. It does so by breaking down**
 - a. a nerve coating called myelin.
 - b. a section of the inner ear called the cochlea.
 - c. the brain's balance center.
 - d. nerve cells in the nose.
8. **Benzene, a toxic component of gasoline fumes, can cause aplastic anemia, an often fatal disease of the**
 - a. liver.
 - b. lungs.
 - c. blood.
 - d. brain.
9. **When toxins from inhalants stay in the body for a long time, they are stored in**
 - a. fatty tissue.
 - b. muscle tissue.
 - c. the inner ear.
 - d. the stomach.
10. **A recent survey found that more than _____ of 8th-graders didn't realize that regular use of inhalants is harmful.**
 - a. 2 percent
 - b. 8 percent
 - c. 38 percent
 - d. 66 percent



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Heads Up: Learning How Inhalants Become Drugs of Addiction

Among the known risks of inhalants are severe brain damage, physical disabilities, and even death. In addition to these risks, new scientific evidence points to how inhalants also act upon the brain like other drugs of addiction.

Recently, two NIDA-sponsored researchers at the University of Arizona in Tucson studied how rats are affected by toluene—a chemical found in many inhalants, including gasoline, spray paint, and glue. If the scientists could show that toluene’s effects on the brain are similar to those of other drugs of addiction, it would help them figure out how to battle inhalant abuse. Read about the experiment, then answer the questions below.

The Experiment: A Change in Dopamine Levels Is Behind a Toluene-Induced Behavior Change

BACKGROUND

Researchers Art Riegel and Edward French knew that when toluene was given to rats, it caused increased motor activity, known as “roaming.” The researchers wanted to see whether this behavioral change in the rats’ motor activity resulted from heightened dopamine activity in their brains’ pleasure center.

It was known that some drugs that cause roaming *and* feelings of extreme pleasure—including the drug amphetamine—do so by increasing dopamine in a region of the brain called the nucleus accumbens

(NAc for short). The NAc is sometimes called the brain’s pleasure center, and dopamine is sometimes called the pleasure chemical.

Dopamine is a naturally occurring brain chemical that is important for pleasure, motivation, and motor activity. When people take drugs that cause the brain to produce unnaturally large quantities of dopamine, it can throw off the brain’s own ability to produce this chemical. Drug abusers become unable to feel pleasure without taking drugs. This is the start of the disease known as addiction.

DESCRIPTION

To test whether the increased roaming in rats that were given toluene is related to dopamine activity, the researchers compared toluene’s effects on two groups of rats. One group was made up of ordinary lab rats. The other group had a procedure done so that dopamine was blocked from reaching the NAc region

of their brains. If the dopamine-blocked rats showed roaming activities, scientists would know it couldn’t be caused by dopamine in the NAc.

Next, scientists injected the two groups with three drugs: toluene, amphetamine (which acts through dopamine in the NAc), and scopolamine (which induces roaming, but *not* through dopamine).

RESULTS

- As the scientists expected, the **normal rats** showed increased roaming when given **toluene**, **amphetamine**, or **scopolamine**.
- The **dopamine-blocked rats** reacted differently. Their roaming response to **toluene** was 55 percent less than in normal rats given toluene. Their roaming response to **amphetamine** was 67 percent less than in normal rats given amphetamine. Their

roaming response to **scopolamine** was the same as in the normal rats.

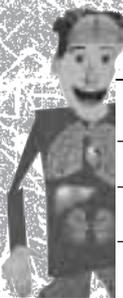
- “The findings put inhalants squarely in the same category as other drugs of abuse, suggesting that a similar mechanism of action is involved,” explained Dr. Riegel. “There is a strong likelihood that they are highly addictive substances and that some of the same strategies that work for other addictions may effectively combat inhalant abuse as well.”

YOU’RE THE SCIENTIST

Now imagine that you’re a scientist trying to understand and interpret this experiment. Answer the following questions.

1. What does dopamine do in our brains in its natural state? How can the dopamine system be damaged by drugs of abuse?
2. Can you think of a reason why the researchers injected the rats not only with toluene, but with amphetamine and scopolamine, too?

3. What do you think the results say about why people might repeatedly abuse inhalants even when they know they are dangerous? How can scientists use this information to help inhalant abusers?



**HEADS UP
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Prescription Drug Abuse: Teens in Danger



—A message from Dr. Nora D. Volkow,
Director of NIDA

In This Installment

- What is prescription drug abuse?
- How does prescription drug abuse cause harm?
- Dangerous myths about prescription drugs
- Sports and steroid abuse

Coming Up in the Next Installment

- Drugs in social settings

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Assessment Opportunities

Look inside for creative science-based lessons and to see how you can test what your students are learning about prescription drug abuse.

Dear Teacher:

A serious threat to your students may be lurking in their families' medicine cabinets. New research by the National Institute on Drug Abuse (NIDA) and other federal agencies is revealing a troubling rise in prescription drug abuse among young people—and among adults as well. The increase in abuse of prescription painkillers by teens has been slight but at a persistent level of high use.



This installment of *Heads Up: Real News About Drugs and Your Body* gives students essential science-based information about prescription drug abuse and the harm posed by the most commonly abused medications. The article explains what prescription drug abuse is—and isn't—and dispels harmful myths.

In addition to sharing and discussing the article with your students, be mindful that parents and other adults should use prescription drugs as directed, then discard any leftover pills. Medications with potential for abuse—particularly pain relievers, antianxiety medications (benzodiazepines), and stimulants—should not be kept in easy-access locations such as medicine cabinets. Your assistance in delivering this important information to students is invaluable; it *does* make a difference.

Thank you for joining me and the team of NIDA scientists in our efforts to bring students the facts about drug abuse. Together, we can all look forward to a day when students across the country understand that abusing drugs—any drugs, whether prescription or street drugs—is never the right decision.

Sincerely,

Nora D. Volkow, MD
Director of NIDA

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Lesson Plans for Student Activities

PREPARATION: Before beginning the lessons, make these photocopies: two copies for each student of Activity 1 Reproducible “Heads Up: Prescription Drug Abuse—A Quiz” (page 11) for a pre-reading and post-reading quiz, and one copy for each student of Activity 2 Reproducible “Heads Up: Social Neuroscience—A New Frontier in the Study of Drug Abuse” (page 12).

Lesson 1 Heads Up: What Do You Know About the Dangers of Prescription Drug Abuse?

OBJECTIVE

To give students science-based facts about prescription drug abuse; to educate students about the most often abused prescription drugs and the harm they can cause; to help students understand that using medicines prescribed for someone else can be dangerous or deadly; and to assess students’ knowledge of the topics before and after reading the article.

NATIONAL SCIENCE EDUCATION STANDARDS

Life Science; Science in Personal and Social Perspective

LESSON STRATEGY

Introducing the Topic

- Before the lesson begins, hold a class discussion based on these questions: *What is a prescription drug? What does it mean to abuse a prescription drug? Is it ever OK to take a prescription drug that was not prescribed specifically for you? Can prescription drugs be as dangerous as illegal drugs?*

- Tell students that they are going to see how much they know about prescription drug abuse and what the latest research is teaching us about it. Distribute copies of Reproducible 1. Tell students to write their names on the paper and label it No. 1. Then have them answer the questions. Collect and grade the papers.

READING, DISCUSSION, AND ASSESSMENT

- Have students read the article “Prescription Drugs: Their Use and Abuse.” Next, hold a discussion based on questions that the article may prompt, such as: *What are some possible reasons that prescription drug abuse is on the rise? List some myths about prescription drug abuse. How do you think people came to believe the myths? What can be done to dispel them? What do you think should be done to stop the abuse of anabolic steroids by professional athletes?*

- Next, tell students it’s time to see how much they’ve increased their knowledge. Give them a second copy of Reproducible 1. Tell them to write their names on the paper and label it No. 2. When students have finished, collect the papers, score them, and compare the results before and after the lesson.

WRAP-UP

- Conclude the lesson by asking students what they think ought to be done to end prescription drug abuse in their community. Does the answer lie in education, better control of the distribution of drugs, or tougher law enforcement? What could be done in each of those three realms that would help lower abuse rates among adults and teens?

ANSWERS TO REPRODUCIBLE QUIZ ON PAGE 11:

1. b; 2. d; 3. d; 4. a; 5. b; 6. a; 7. c; 8. d; 9. d; 10. b; 11. c.

Lesson 2 Heads Up: Understanding Social Neuroscience

OBJECTIVE

Students gain an understanding about how social environment affects brain chemistry and susceptibility to drug abuse.

NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry; Science in Personal and Social Perspective

LESSON STRATEGY

Introducing the Topic

- Discuss with students what they know about the brain chemical dopamine: it is a neurotransmitter that causes feelings of pleasure when it binds with dopamine receptors in the brain. Review how drug abuse can interfere with the dopamine system. (See Reproducible 2 for details.)

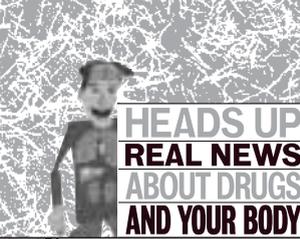
- Ask students if they think a person’s environment can affect how likely he or she is to abuse drugs. Ask if they think the effect is totally psychological, or if environment could actually affect brain chemistry.
- Tell students they are going to read about a NIDA-sponsored experiment with monkeys that investigated how and why being in a socially stressful or enriched environment can affect susceptibility to drug abuse. Explain that this line of research is called *social neuroscience*. Discuss what they think the term might mean. Break it down by discussing the meaning of the individual words—“social” and “neuroscience.”
- Hand out Reproducible 2. Have students read the sheet and answer the questions at the end.

ANSWERS TO REPRODUCIBLE QUESTIONS ON PAGE 12:

1. The monkeys in the enriched environment had 20 percent more dopamine receptor function.
2. The monkeys that experienced a stressful environment. A possible reason may be that being in an enriched environment had a positive influence on whether the monkeys took drugs.

Answers to questions 3 and 4 will vary.

- Wrap up the lesson by discussing the following questions: *What is social neuroscience? How can findings from social neuroscience help scientists find new ways to prevent drug abuse? Can you think of any social neuroscience experiments that could be conducted with humans?*

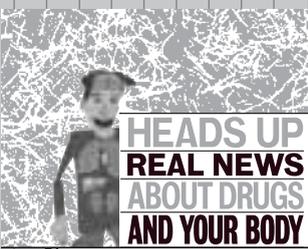


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Heads Up: Prescription Drug Abuse—A Quiz

Test your knowledge of prescription drug abuse by answering the questions below.

1. **A prescription drug cannot legally be bought or sold without**
 - a. a safety cap.
 - b. a doctor's permission.
 - c. a pharmacist's permission.
 - d. a parent's permission.
2. **Which of the following is safe to do if you're in serious pain?**
 - a. take a pain medication prescribed for your mother
 - b. take a pain medication prescribed for a friend
 - c. take double the dose that is prescribed for you
 - d. none of the above
3. **Opioids are prescription drugs used to treat**
 - a. viruses.
 - b. obesity.
 - c. infection.
 - d. pain.
4. **When abused, opioids can result in death by**
 - a. stopping one's breathing.
 - b. stroke.
 - c. speeding up the heartbeat.
 - d. causing the body to overheat.
5. **Certain prescription stimulants are used to treat**
 - a. sleeplessness.
 - b. attention-deficit/hyperactivity disorder.
 - c. pain.
 - d. autoimmune disorders.
6. **Abuse of prescription stimulants can result in**
 - a. high body temperature.
 - b. infection.
 - c. depressing respiration.
 - d. liver cancer.
7. **Benzodiazepines are also known as**
 - a. stimulants.
 - b. steroids.
 - c. antianxiety medications.
 - d. painkillers.
8. **Which drug has been in the news because of its abuse by athletes who want to build strength and endurance?**
 - a. Ritalin
 - b. opioids
 - c. OxyContin
 - d. anabolic steroids
9. **Abusing steroids can result in**
 - a. facial hair growth in women.
 - b. premature heart attacks.
 - c. psychiatric problems.
 - d. all of the above.
10. **Two of the most commonly abused opioids are**
 - a. Valium and Adderall.
 - b. OxyContin and Vicodin.
 - c. Xanax and Librium.
 - d. Oxandrin and Anadrol.
11. **A recent survey of Americans ages 12 and older found that _____ abused a prescription drug at least once in 2004.**
 - a. 1.3 percent
 - b. 4.3 percent
 - c. 6.1 percent
 - d. 9.3 percent



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Heads Up: Social Neuroscience—A New Frontier in the Study of Drug Abuse

Introduction: Drug Abuse and Dopamine

Under normal circumstances, dopamine (a brain chemical) is released in your brain when something pleasurable happens. When a drug abuser takes a drug, it causes an unnaturally large flood of dopamine in the brain. Over time, the brain gets used to having all the extra dopamine around. As a result, the number of dopamine receptors in the brain starts to drop. Because of that, the abuser can't feel pleasure without the huge flood of dopamine that only drugs can provide.

By studying the dopamine system, NIDA scientists have discovered that people who happen to have fewer dopamine receptors in their brains are more likely to feel pleasure when exposed to drugs that enhance the

dopamine system. That may in turn make them vulnerable to abusing drugs.

Now, NIDA researchers are trying to find out what causes variation in dopamine receptors. It is turning out that environment can actually influence brain chemistry, including the number of dopamine receptors in the brain. This has led to a new field of research called **social neuroscience**. This research examines how neurobiology and the social environment interact in the processes of initiation, maintenance, relapse, and treatment of abuse and addiction. Read below about a social neuroscience experiment involving monkeys, their environment, and drug use, then answer the questions below.

The Experiment: Social Environment and Dopamine Receptors

Description

- Researchers measured the number of dopamine D₂ receptors in a group of monkeys' brains using positron-emission tomography (PET). At this time, the monkeys were housed individually.
- Researchers then housed the monkeys in groups of four, and social hierarchies formed naturally. Some monkeys became dominant and some became subordinate. For those that became dominant, the new environment modeled "environmental enrichment," but for those that became subordinate, it modeled "socially derived stress."
- After the social hierarchies were formed (3 months), the researchers again scanned the monkeys' brains using PET. They discovered that the monkeys that

had experienced a socially enriched environment had 20 percent more dopamine receptor function than when they had been housed individually. The dopamine receptor levels of the monkeys that were experiencing socially derived stress, however, were unchanged.

- After the last PET scan, the monkeys were taught to operate machines that dispensed cocaine. They could take cocaine whenever they wanted it.

Findings The dominant monkeys took much less of the drug than the subordinate monkeys.

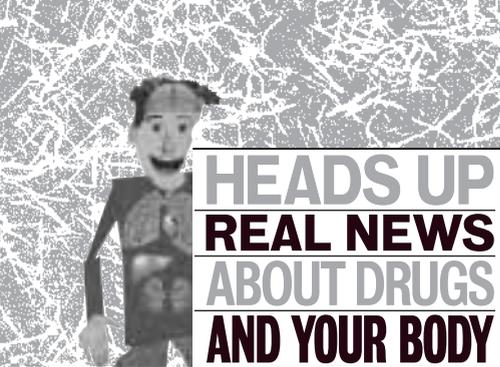
Implications These findings suggest that, regardless of an individual's past, positive environmental change may result in biological changes that "protect" the individual from the pleasurable or motivational effects of drugs.

	Dominant Monkeys	Subordinate Monkeys
Environment →	Enriched	Stressed
Dopamine receptor function →	20% higher	Unchanged
Response to available cocaine →	Took a little	Took a lot

You're the Scientist

Imagine that you're a scientist trying to understand and interpret this experiment. Answer the following questions on the back of this page.

1. How did experiencing an enriched environment affect the concentration of dopamine receptors in the monkeys' brains?
2. Which monkeys took more of the drug—those that experienced an enriched environment, or those that experienced a stressful environment? What is a possible reason for this?
3. What are some stressful environments for humans? What are some examples of enriched environments?
4. Based on this research, what can people do to protect themselves from drug abuse and addiction?



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Drug Abuse in Social Settings: A Serious Risk for Teens



—A message from
Dr. Nora D. Volkow,
Director of NIDA

In This Installment

- The science of why it's hard to say no
- Drug-refusal strategies
- Looking inside the teen brain
- What to do if you see someone overdosing

Assessment Opportunities

Look inside for creative, science-based lessons and to see how you can test what your students have learned about drug-abuse trends, drug abuse in social settings, and effective ways to say “No, thanks.”

Dear Teacher:

Teens are social beings. As a teacher who works with adolescents, you definitely won't find that shocking! Probably more than anyone, you understand how important it is for teens to feel like they fit in—that they're part of the crowd.

Unfortunately, this strong social instinct among teens—which certainly has some positive aspects—can put them at high risk for drug abuse, especially in social settings such as parties and after-school



hangout sessions. This year's fourth and final installment of *Heads Up: Real News About Drugs and Your Body* deals with the issues of adolescent drug abuse in social situations.

The issues are real and important. Researchers have found that most teens who abuse drugs first do so in social settings. If we can cut off this route to drug abuse and addiction, we may save many young people from lifetimes of drug-related problems.

This article in the *Heads Up* series presents the issue to readers in a straightforward way, and reveals the science behind *why* it can be so tough for teens to make smart decisions in social settings. It also offers research-tested drug-refusal strategies that students can draw on as they navigate the teen social maze this summer.

Along with this sober subject matter, the article also shares good news. The results for 2005 are in from NIDA's annual Monitoring the Future survey, and teen drug use is stable, with indications of a continuing general decline for a record fifth year in a row, except for certain prescription drugs.

Thank you for working with me and the team of NIDA researchers to bring science-based facts about drug abuse to your students. By taking classroom time to share the lessons of *Heads Up* with your students this year, you have helped to set the stage for a healthier, smarter, drug-free generation of young adults. You are truly making a difference.

Sincerely,

Nora D. Volkow, MD
Director of NIDA

For printable past and current articles in the **HEADS UP** series, as well as activities and teaching support, go to www.drugabuse.gov/parent-teacher.html or www.scholastic.com/HEADSUP.

Lesson Plans for Student Activities

PREPARATION: Before beginning the lessons, make these photocopies: Two copies for each student of Activity 1 Reproducible “Heads Up: Drugs in Social Settings—A Quiz” (page 15) for a pre-text and post-text quiz, and one copy for each student of Activity 2 Reproducible “Heads Up: Teens and Drug Abuse—Understanding the Statistics” (page 16).

Lesson 1 Heads Up: What Do You Know About Drug Abuse in Social Settings?

OBJECTIVE

To give students science-based facts about why the risk for drug abuse is higher in social settings such as parties; to show students that abusing drugs is not the norm among teens; to provide students with research-tested drug-refusal strategies; and to assess students’ knowledge of the topics before and after reading the article.

NATIONAL SCIENCE EDUCATION STANDARDS

Life Science; Science in Personal and Social Perspective

LESSON STRATEGY

Introducing the Topic

- Before the lesson begins, hold a class discussion based on these questions: *Where do you think most kids who abuse drugs have their first drug experience? Why is it sometimes difficult to say no in a social setting; for example, if someone offers you a slice of cake or a piece of candy after you have made up your mind to get healthier by avoiding refined*

carbs? Could those same reasons apply to turning down drugs? Why do some teens have a hard time saying no to drugs at parties—even when they don’t really want them?

- Tell students that they are going to see how much they know about the latest research into teen drug abuse in social settings and drug-refusal strategies. Distribute copies of Reproducible 1. Tell students to write their names on the paper and label it No. 1. Then have them answer the questions. Collect and grade the papers.

READING, DISCUSSION, AND ASSESSMENT

- Have students read the article “A Day in the Life of a Teen.” Next, hold a discussion based on these questions: *Are you surprised to learn that most teens overestimate the amount of drug abuse among their peers? How might the media play a role (TV, movies, news programs, etc.)? Why is the urge to imitate so powerful*

among adolescents? How can you resist it? Should teens avoid social situations as a way of avoiding the temptation to use drugs? Why or why not?

- Next, tell students it’s time to see how much they’ve increased their knowledge. Give them a second copy of Reproducible 1. Tell them to write their names on the paper and label it No. 2. When students have finished, collect the papers, score them, and compare the results before and after the lesson.

WRAP-UP

- Conclude the lesson by asking students what they think would be the best way to teach teens drug-refusal skills: giving them materials to read, or offering opportunities to role-play tough social situations? Discuss whether your school ought to offer classes, and whether they should be optional or mandatory.

ANSWERS TO REPRODUCIBLE QUIZ ON PAGE 15:

1. b; 2. a; 3. d; 4. b; 5. c; 6. b; 7. a; 8. c; 9. b; 10. d.

Lesson 2 Heads Up: Understanding Drug-Abuse Statistics

OBJECTIVE

To help students develop an understanding of statistics, find out how scientists collect and use statistics, and use their knowledge to interpret data from the 2005 Monitoring the Future survey (www.monitoringthefuture.org), an annual study of the behaviors, attitudes, and values of teens in America.

NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry; Science in Personal and Social Perspective

LESSON STRATEGY

Introducing the Topic

- Explain to students that statistics is a branch of math dedicated to answering questions by using numbers. Scientists use statistical methods to collect, analyze, and draw conclusions from data. Have students think of ways in which statistics are used to help people understand the world. (Examples may include baseball statistics and student-performance analyses, such as class rank.)
- Tell students that many types of

scientists use statistics. One of the most common statistical tools is the survey or poll. In a survey to track drug use among teens, for example, a scientist might ask survey participants whether they have used a particular drug in the past 12 months. Scientists analyze the results to determine facts about drug use among teens. Have students recall surveys they have heard about lately. What do they think was the purpose of those surveys?

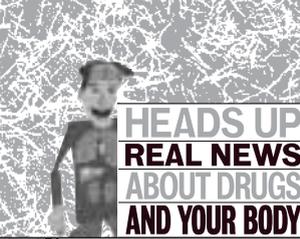
- Explain to students that, in general, the larger the number of people surveyed, the more accurate the survey results will be. Statisticians (mathematicians who study statistics) call the number of people surveyed the sample size. If you ask 10 teens the question, “Do you consider drug abuse to be dangerous?” you will not get a reliable snapshot of how teens nationwide feel about the dangers of drugs. But if you have a sample size of 50,000 teens from all 50 states, you are more likely to get an accurate picture.

- Hand out Reproducible 2. Tell students that they are about to examine and analyze parts of a real statistical study that provides facts about teen drug use.
- Wrap up the lesson by discussing the following questions: *Why do scientists collect statistics? How do statistics help in the battle against drug abuse? Were you surprised by any of the data you examined in the reproducible? Why? What type of questions would you include in a Monitoring the Future-style survey in your school?*

For more information about the Monitoring the Future study, refer students to www.monitoringthefuture.org.

ANSWERS TO “YOU’RE THE SCIENTIST” QUESTIONS ON PAGE 16:

1. Rose sharply from 1999 to 2001; began to decline after 2001.
2. Fell from 1999 to 2003. (Small rise in 2004 was not statistically significant.) Fell further between 2004 and 2005. Word: Decline.
3. Methamphetamine abuse showed steady decline; ecstasy abuse rose, then fell.
4. Ecstasy did after an initial increase and methamphetamine followed the trend.

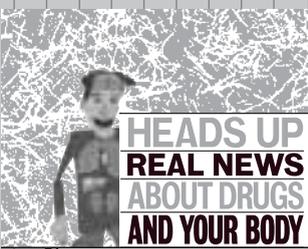


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Heads Up: Drugs in Social Settings—A Quiz

See how much you learned from the article by answering the questions below.

1. **What percentage of 10th-grade students say they've used illicit drugs in the last year?**
 - a. 50 percent
 - b. nearly 30 percent
 - c. 15 percent
 - d. less than 5 percent
2. **When teens guess how many of their peers use illicit drugs, the guess is usually**
 - a. too high.
 - b. too low.
 - c. about right.
 - d. exactly right.
3. **The part of the brain known as the prefrontal cortex is fully developed**
 - a. around age 5.
 - b. around age 10.
 - c. around age 15.
 - d. around age 25.
4. **The last part of the brain to develop is the area responsible for**
 - a. emotions.
 - b. decision-making and impulse control.
 - c. understanding complex facts.
 - d. breathing.
5. **When you see others use illicit drugs, it can be tempting because the brain is wired to learn first by**
 - a. repetition.
 - b. rote.
 - c. imitation.
 - d. reading.
6. **Most teens _____ the amount of pressure others will put on them to use illicit drugs.**
 - a. underestimate
 - b. overestimate
 - c. don't care about
 - d. read about
7. **As a teen, each time you repeat an activity or skill the pathways in your brain are**
 - a. strengthened.
 - b. unchanged.
 - c. weakened.
 - d. not used.
8. **Practicing saying "No, thanks" to drugs _____ teens' likelihood of abusing drugs.**
 - a. raises
 - b. has no effect on
 - c. lowers
 - d. confuses
9. **If you suspect a friend may be overdosing on drugs or alcohol, you should**
 - a. let your friend try to sleep it off.
 - b. call 911 immediately.
 - c. wait 10 minutes, then decide what to do.
 - d. give your friend coffee.
10. **Which of the following is a symptom of a drug overdose?**
 - a. extreme confusion
 - b. seizures
 - c. loss of consciousness
 - d. all of the above



**HEADS UP
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Heads Up: Teens and Drug Abuse— Understanding the Statistics

Introduction: 2005 Monitoring the Future Survey

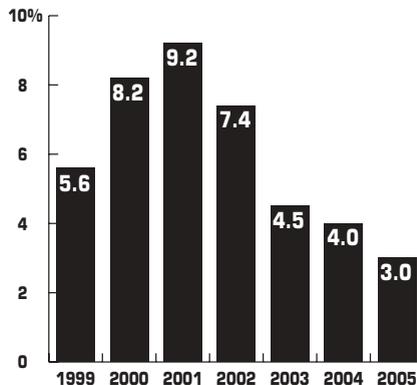
- One of scientists' main tools for understanding drug-abuse trends among teens is the annual Monitoring the Future survey. In this survey, approximately 50,000 8th-, 10th-, and 12th-grade students in public and private schools across the country answer questions that provide information about teen drug-abuse behaviors and attitudes. The Monitoring the Future survey has been done essentially the same way for more than 30 years, so scientists trust the trends that the data reveal.
- Students participating in the survey fill out questionnaires in school. (All answers are kept confidential.) Scientists then tally and analyze the answers. They compare the current year's results with those from previous years to see how drug abuse among teens is changing. Armed with these results, scientists can target research and drug abuse prevention efforts in areas that most need them.
- Scientists must take precautions when interpreting the Monitoring the Future results. For example, an increase in the percentage of students saying they've used a particular drug *doesn't* necessarily mean use of that drug is on the rise. The rise has to be larger than the **margin of error**, which is an estimate of how a survey would vary if it were taken multiple times using a different group of people each time. Statisticians (mathematicians who study statistics) have devised formulas to determine the margin of error and whether a result is or isn't **statistically significant**, meaning it didn't happen by pure chance. The formulas take into account sample size (number of people surveyed), the number of possible answers, and the number of people giving each answer. Scientists use the formulas to help them analyze data from surveys such as Monitoring the Future.

Interpreting the Data: Findings From the 2005 Monitoring the Future Survey

Now it's your turn to analyze and interpret statistics from the 2005 Monitoring the Future survey. The two bar graphs below chart 12th-graders' use of two drugs with very harmful health consequences: ecstasy and methamphetamine.

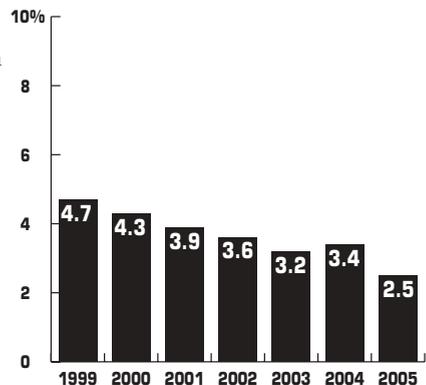
Percentage of 12th-grade students saying they used ecstasy at least once in 12 months leading up to the survey

Ecstasy (MDMA):
A human-made drug chemically similar to both stimulants and hallucinogens. Research in animals indicates it can damage the brain. In high doses, it can lead to organ damage, including heart failure, and to rare but potentially lethal hyperthermia.



Percentage of 12th-grade students saying they used methamphetamine at least once in 12 months leading up to the survey

Methamphetamine:
A stimulant with high potential for addiction. Abuse also can lead to psychotic behaviors and stroke.



You're the Scientist

Write your answers on the back of this page.

1. How did ecstasy abuse among 12th-graders change between 1999 and 2005? When did it rise? When did it fall?
2. How did methamphetamine abuse among 12th-graders change between 1999 and 2005? What word best describes the overall trend?
3. What is the main difference between the ecstasy graph and the methamphetamine graph? (Don't look at the numbers; look at the general trends shown in the graphs.)
4. The Monitoring the Future survey has found a general decrease in drug abuse among teens since the late 1990s. Did ecstasy and methamphetamine follow this trend?