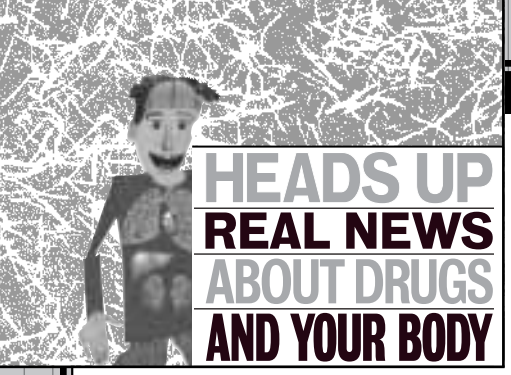


Inhalants: A Looming Threat for All Teens

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

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.

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

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 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

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 for a pre-reading and post-reading quiz, and one copy for each student of Activity 2 Reproducible.

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 QUIZ QUESTIONS:

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.

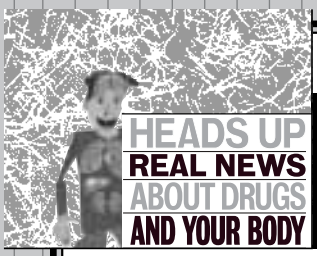
  Based on what they've already learned about inhalants from the article, ask students the following: *Why do you think inhalants can be classified as a drug of addiction?*
- Next, explain that students are going to read about an experiment in which researchers tested rats to find out how their brains 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 2:

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.



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.

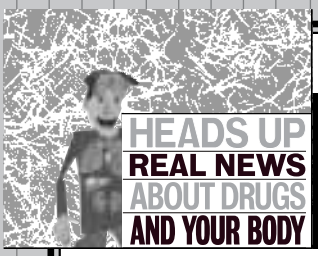
a. 2 percent

b. 8 percent

c. 38 percent

d. 66 percent

FROM SCHOLASTIC AND THE SCIENTISTS OF THE NATIONAL INSTITUTE ON DRUG ABUSE, NATIONAL INSTITUTES OF HEALTH, U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES



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?

Study adapted from www.drugabuse.gov/NIDA_notes/NNvol19N5/Dopamine.html.