

### In This Installment

- \* Why drug addiction is a disease
- \* The science of drug addiction
- \* How drugs change the way the teen brain works
- \* How drugs change how the teen brain develops

### Coming Up in the Next Installment

Teens, Drug Abuse, and AIDS: The Deadly Connection

### Assessment Quiz

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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 the disease of drug addiction.

To order additional free copies of this Heads Up Teacher Edition, call 800-729-6686 and refer to NCADI MS978. For the accompanying Student Edition, refer to NCADI MS977.

# HEADS UP REAL NEWS ABOUT DRUGS AND YOUR BODY

## Addiction is a Disease Why the Teen Brain Is Vulnerable

### Dear Teacher:

The National Institute on Drug Abuse and Scholastic Inc. are deeply committed to bringing students the real, science-based facts about drugs so they can make smart decisions regarding their health. Toward that end, we are launching the third edition of *Heads Up: Real News About Drugs and Your Body*.

Over the course of the next four months, we will bring you a series of articles about addiction that will help

students understand the effects of addiction on teen brains and bodies.

Thank you for helping your students get the scientific facts about drugs and their bodies.

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](http://www.drugabuse.gov/parent-teacher.html) or [www.scholastic.com/HEADSUP](http://www.scholastic.com/HEADSUP).

[www.claris.com](http://www.claris.com)

## Lesson Plans for Student Activities

**Preparation:** Before displaying the poster, make two photocopies for each student of the Activity 1 Reproducible “How Much Do You Know About Drug Addiction?” (page 3). Then make one photocopy for each student of the Activity 2 Reproducible “Drug Abuse Affects Decision Making” (page 4).

### Lesson 1: Heads Up: How Much Do You Know About Drug Addiction?

**OBJECTIVE** To test students’ self-knowledge about drug addiction before and after reading the article

#### NATIONAL SCIENCE EDUCATION STANDARDS

Life Science; Science in Personal and Social Perspective

#### WHAT YOU WILL DO

- Before the lesson begins, ask students, “What do you know about drug addiction?” and “What do you think happens to a person’s brain when they are addicted to drugs?” Give students time for discussion.
- Tell students you are going to find out what they really know about drug addiction.

Distribute copies of Student Activity Reproducible 1. Tell students to write their name on the paper, date it, label the paper #1, and answer the questions. Collect the papers when they are done.

- Have students silently read the article, “Drug Addiction Is a Disease.” When they have finished, begin a discussion by asking the following: How would you define addiction? Why is addiction a disease? What do drugs do to the teen brain?
- After the discussion, tell students you are going to find out if they know more about drug addiction and their

bodies than they did before. Distribute a second copy of Student Activity Reproducible 1. Tell students to write their name on the paper, date it, label the paper #2, and answer the questions. After students are done, collect the papers and score their answers.

- Wrap up the lesson by asking students: “Why are drugs dangerous?” and “What can you do to prevent drug abuse?”

#### ANSWERS TO REPRODUCIBLE QUIZ ON PAGE 3:

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

### Lesson 2: Heads Up: Drug Abuse Affects Decision Making

**OBJECTIVE** Students use scientific data to draw their own conclusions about the effects of drug use on the brain

#### NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry; Science in Personal and Social Perspective

#### WHAT YOU WILL DO

- Tell students that scientists have long known that drugs damage the brain’s limbic system. Now, scientists are discovering that drug abuse also harms other parts of the brain. Ask students what parts of the brain they know about and what might happen if

these parts were damaged.

- Have students define the word *hypothesis*. If necessary, explain that a hypothesis is a scientific word for an assumption. Scientists come up with a hypothesis, then do experiments to prove the hypothesis true or false.
- Tell students they are going to look at a real scientific study. The study tests the hypothesis that drug abusers make poor decisions because the drugs have damaged their prefrontal cortex.
- Distribute Student Activity Reproducible 2. Have students complete it.

- Wrap up the lesson by asking students: “Why do you think it is important to do research studies?” and “What kind of study about drugs and the body would you do?”

#### ANSWERS TO REPRODUCIBLE QUESTIONS ON PAGE 4:

1. Group A (drug abusers) and Group B (brain damaged) were most alike. The most different were Group B (brain damaged) and Group C (healthy). 2. People who abused drugs made decisions similar to those of people with brain damage. 3. Yes.



# HEADS UP REAL NEWS ABOUT DRUGS AND YOUR BODY

Name \_\_\_\_\_ Date \_\_\_\_\_

## How Much Do You Know About Drug Addiction?

Answer the questions below to find out what you know about drugs and drug addiction.

**1. Drug addiction is best defined as:**

- a. a bad habit.
- b. a disease that is characterized by occasional drug use that temporarily changes a person's behavior.
- c. a disease that is characterized by the controlled use of drugs.
- d. a disease that is characterized by an uncontrollable, compulsive urge to seek and use drugs.

**2. Teenagers' brains are:**

- a. the same as adult brains.
- b. the same as adult brains with the exception of the parietal lobes, which are still forming.
- c. completely formed.
- d. different from adult brains.

**3. The part of the brain in which emotional reactions are created is called:**

- a. the cerebellum.
- b. the parietal lobes.
- c. the prefrontal cortex.
- d. the limbic system.

**4. The part of the brain that adults use to make long-term plans and decisions is called:**

- a. the prefrontal cortex.
- b. the parietal lobes.
- c. the cerebellum.
- d. the limbic system.

**5. Most drugs of abuse act on:**

- a. the parietal lobes.
- b. the limbic system.
- c. the cerebellum.
- d. the prefrontal cortex.

**6. Drugs interfere with:**

- a. the ability of the brain to produce white matter.
- b. the ability of the brain to use white blood cells.
- c. the chemical communication between brain cells.
- d. the ability of brain cells to use hemoglobin.

**7. When teens smoke cigarettes, they:**

- a. become addicted to nicotine more quickly than adults.
- b. are not affected by nicotine.
- c. become addicted to nicotine at the same rate as adults.

- d. become addicted to nicotine less quickly than adults.

**8. Most adults who are addicted to drugs started using them:**

- a. when they were teenagers.
- b. as adults at parties.
- c. in their early twenties.
- d. as adults, who use drugs to relax.

**9. Dopamine is:**

- a. a type of white matter in the brain that receives messages in the cerebrum.
- b. a natural chemical in the brain that carries messages in the parietal lobes.
- c. a natural chemical in the brain that carries messages in the limbic system.
- d. a type of gray matter in the brain that receives messages in the parietal lobes.

**10. In teenagers, drug use interferes with:**

- a. bone formation.
- b. normal brain development.
- c. the ability to use the parietal lobes for decision making.
- d. the quadriceps muscles.



# HEADS UP REAL NEWS ABOUT DRUGS AND YOUR BODY

Name \_\_\_\_\_ Date \_\_\_\_\_

## Drug Abuse Affects Decision Making

One puzzling symptom displayed by individuals addicted to drugs is their decision to continue abusing drugs, even when there are harmful consequences to themselves and others. At the University of Iowa in 1999, Dr. Antoine Bechara and his fellow scientists created an experiment to find out more about why this happens. In the activity below, read about the experiment they conducted and its results, then draw conclusions about what was discovered.

### The Bechara Card Task Experiment

**Question:** Does drug use interfere with people's ability to make decisions that will benefit them in the long term?

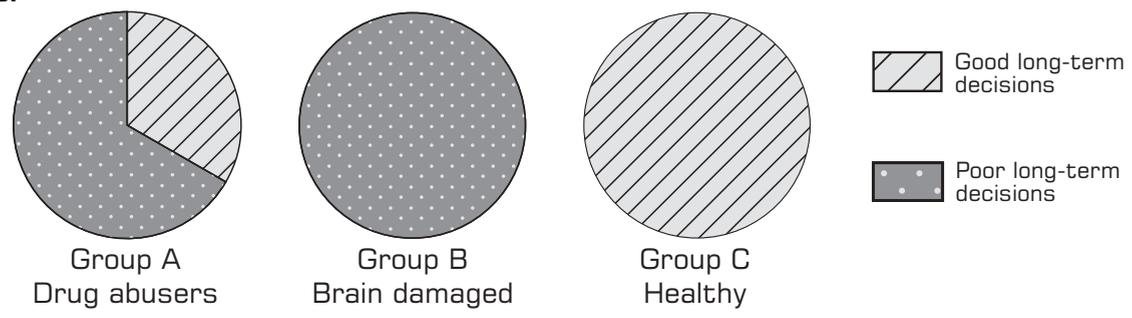
**Hypothesis:** Some drug users make poor decisions because the drugs have damaged a part of their brain known as the *prefrontal cortex*.

**Brief Description of Experiment:** Three groups (A, B, and C) played a computerized card game three times. Group A consisted of 46 people who had abused drugs; Group B consisted of 10 people who had prefrontal cortex damage from an injury or a disease; Group C consisted of 49 healthy people who had never abused drugs or had a brain injury or disease.

point value in the short term, but little or no value over the long term. The other two decks represented long-term benefits: the cards had low point value in the short term, but gained more points over the long term. For example, if a player chose a card from Deck A, getting a 100-point short-term gain, but a 200-point long-term loss, the player could decide to choose the next card from Deck B, which may have only a 10-point short-term gain, but a 100-point long-term gain. As players chose cards, it became apparent that to accumulate the highest possible number of points, players had to make decisions that benefited them in the long term. To accumulate the most points, players had to ignore the short-term benefit decks of cards, and choose cards from the long-term benefit decks.

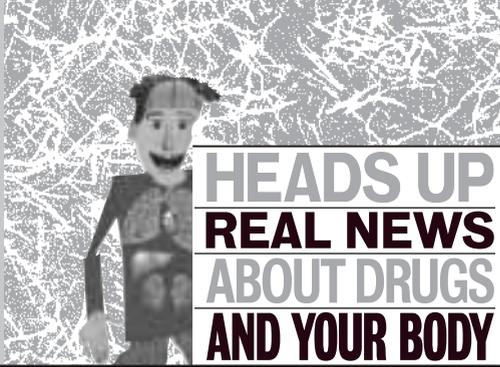
The card game was designed so that participants had to make decisions involving short-term benefits and long-term consequences. Researchers assessed players' decisions as they made selections from four decks of cards. The object of the game was to accumulate the most points. Two decks of cards represented short-term benefits: the cards had high

### Results:



Now that you have read the experiment and studied the results, answer these questions. Write your answers on the back of this page.

1. Which groups were most alike? Which groups were least alike?
2. What conclusions can you draw from these results?
3. Does the hypothesis seem correct?



**HEADS UP  
REAL NEWS  
ABOUT DRUGS  
AND YOUR BODY**

# Drug Abuse and AIDS: How Young People Are at Risk



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

## In This Installment

- How Drug Abuse Increases the Risk of HIV and Hepatitis C
- The Science of Blood-borne Diseases
- How Drugs Weaken the Immune System
- Connections to Real-World Behavior

## Coming Up in Future Installments

- Methamphetamine, Prescription Drugs, and Inhalants
- The Link Between Addiction and Obesity

## Assessment Guide

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 and AIDS.

## Dear Teacher:

More than ever before, teens today are at risk for the deadly blood-borne illnesses AIDS and hepatitis C. We know for a fact that drug abuse is the single largest factor driving this troubling trend.



How is that so? We have long understood that blood-borne viruses are spread by behaviors related to drug use, such as sharing contaminated needles. In addition, research indicates that many drugs of abuse can affect judgment, which means that teens under the influence of drugs are more at risk for behaviors that can lead to the transmission of blood-borne viruses. Perhaps even more disturbing, though, is another fact also at play: Drug abuse causes long-term changes to the parts of the brain responsible for decision making.

In this installment of **HEADS UP: Real News About Drugs and Your Body**, we give students the facts about the connection between teen drug abuse and blood-borne illnesses. We also explain the science of AIDS and hepatitis C and show how research is illuminating new ways to fight and understand these diseases *and* the disease of addiction. Finally, we remind students that when they are armed with information that will enable them to make smart choices, they are in a unique position to fight the spread of HIV and hepatitis C—creating a safer world for themselves and their peers.

Thank you for bringing this enormously important scientific information to your students. You are truly a key player in the fight against addiction and disease.

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](http://www.drugabuse.gov/parent-teacher.html) or [www.scholastic.com/HEADSUP](http://www.scholastic.com/HEADSUP).

## Lesson Plans for Student Activities

**Preparation:** Before beginning the lessons, make two photocopies for each student of Activity 1 Reproducible “What Do You Know About Teens, Drugs, and Disease?” (page 7) and one copy for each student of Activity 2 Reproducible “Heads Up: The Rising HIV Rates Among Girls and Women” (page 8).

### Lesson 1: What Do You Know About Teens, Drugs, and Disease?

**OBJECTIVE** To educate students about the connection between drug abuse and blood-borne illnesses, and to test their knowledge of the topic before and after they read the article

#### NATIONAL SCIENCE EDUCATION STANDARDS

Life Science; Science in Personal and Social Perspective

#### WHAT YOU WILL DO

- Before the lesson begins, hold a class discussion based on these questions: “What do you know about AIDS and hepatitis C?” “What do you think puts people at risk for these diseases?” “How might drug abuse be involved?”
- Tell students they are going to see how much they know about HIV, hepatitis C, and the drug-abuse connection. Distribute copies of Student Activity 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.
- Have students read the article, “**Heads Up: Teens, Drug Abuse, and AIDS: The Deadly Connection.**” Next, hold a discussion based on these questions: How are HIV and hepatitis C transmitted? Are teens at risk? How does drug use help spread these diseases?
- Next, tell students it’s time to see how much they’ve increased their knowledge. Give them a second copy of Student Activity Reproducible 1. Tell them to write their names on the paper and label it No. 2. When students have finished, collect the papers and score them.
- Wrap up the lesson by discussing how students can protect themselves and their friends from AIDS and hepatitis C.

#### ANSWERS TO REPRODUCIBLE QUIZ ON PAGE 7:

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

### Lesson 2: Heads Up: The Rising HIV Rates Among Girls and Women

**OBJECTIVE** Students use scientific data to analyze and draw conclusions about the effects of the worldwide AIDS epidemic on women.

#### NATIONAL SCIENCE EDUCATION STANDARDS

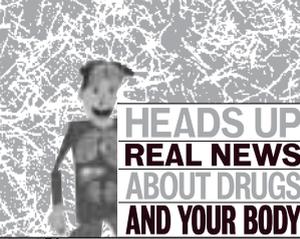
Science as Inquiry; Science in Personal and Social Perspective

#### WHAT YOU WILL DO

- Tell students that an *epidemiologist* is a scientist who studies epidemics. Explain that one important way these scientists learn about epidemics is by examining data that show who is developing a particular illness. Studying these statistics and the way they change over time helps scientists figure out the best ways to fight epidemics. Generate discussion by asking students: “Why does knowing who gets a disease help epidemiologists formulate plans to fight the illness?”
- Tell students they are now going to look at a table. The table compares the number of HIV infections among girls and women in 10 regions of the world in 2002 and 2004.
- Distribute Reproducible 2. Have students complete the reproducible.
- Wrap up the lesson by asking students: “Why does looking at statistics on a table or graph make it easier to see patterns?” and “What other information and statistics would help AIDS policy-makers figure out how to fight the epidemic?”

#### ANSWERS TO REPRODUCIBLE QUESTIONS ON PAGE 8:

1. Sub-Saharan Africa, North Africa and the Middle East, and the Caribbean; 2. South and Southeast Asia; 3. Answers will vary, but may include “Increase AIDS-education programs for young women” and “Institute programs to fight sex discrimination and empower women.”

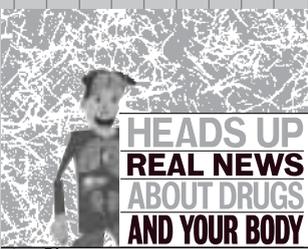


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ABOUT DRUGS  
AND YOUR BODY**

## What Do You Know About Teens, Drugs, and Disease?

Test your knowledge about how drug abuse is linked to **AIDS, HIV** (the virus that causes AIDS), and **hepatitis C**. Answer the questions below.

- Next year, people between the ages of 13 and 25 will account for what portion of new HIV infections?**
  - one tenth.
  - one quarter.
  - one sixth.
  - all.
- How many people have died from AIDS since the epidemic began?**
  - 20,000.
  - 200,000.
  - 2 million.
  - 20 million.
- What does hepatitis C have in common with HIV?**
  - It is transmitted through contact with infected blood or other body fluids.
  - It is caused by a virus.
  - A person can spread the disease and not even know he or she has it.
  - all of the above.
- Which of the following is NOT a reason that drug addiction increases a person's risk of getting HIV and hepatitis C?**
  - The drugs themselves are often contaminated with these viruses.
  - Drug addiction harms a person's decision-making ability.
  - Drug use can weaken a person's ability to fight off infection.
  - Drug addicts tend to follow riskier sexual practices, making it more likely they'll come into contact with the viruses.
- AIDS destroys the body's immune system, which is responsible for:**
  - digesting food.
  - fighting disease.
  - the aging process.
  - growth.
- AIDS researchers have found:**
  - a cure for AIDS.
  - a vaccine to protect against AIDS.
  - a cure and a vaccine.
  - no cure and no vaccine.
- The main way injection-drug abusers spread AIDS and hepatitis C is by:**
  - sharing contaminated drug-injection equipment.
  - sneezing and coughing while using drugs.
  - selling contaminated drugs.
  - inhaling drugs.
- Drug abuse harms a part of the brain important in long-term decision making. It is:**
  - the cerebellum.
  - the brain stem.
  - the prefrontal cortex.
  - the occipital lobe.
- Drug abusers can lower their risk of getting AIDS or hepatitis C by:**
  - getting extra sleep.
  - starting a drug treatment program.
  - taking vitamins.
  - switching drugs.



**HEADS UP  
REAL NEWS  
ABOUT DRUGS  
AND YOUR BODY**

## Heads Up: The Rising HIV Rates Among Girls and Women

December 1 was World AIDS Day. The theme was *Women, Girls, HIV, and AIDS*. This theme was chosen because epidemiologists studying the disease are finding that females don't have the same access to AIDS prevention and treatment services as men. In order to understand how AIDS is affecting women, epidemiologists study data showing how the infection rates change over time. The table below presents some recent data. Look at the table, then answer the questions.

### How to Fight AIDS in Women

**Question:** What regions of the world are most in need of increased HIV/AIDS services for women? What kinds of services are needed?

**Background Information for Data Interpretation:**

The worldwide AIDS epidemic is affecting females in increasing numbers, especially young women and girls. Even so, a recent UNICEF survey found that up to half of young women in countries where AIDS has a high prevalence did not know the basic facts about AIDS. In addition to a lack of education,

researchers say discrimination against women also puts females at risk. Why? Most women and girls get HIV from sex partners who practice high-risk behavior (drug taking and unprotected sex). In many parts of the world, discrimination makes it impossible for women to speak out against the men who endanger them.

Region	2002 Number of Girls and Women Living with HIV (15-49)*	2004 Number of Girls and Women Living with HIV (15-49)*	2002 Total Adults Living with HIV*	2004 Total Adults Living with HIV*
Caribbean	190,000	210,000	388,000	429,000
East Asia	160,000	250,000	760,000	1,100,000
Eastern Europe and Central Asia	330,000	490,000	1,000,000	1,400,000
Latin America	520,000	610,000	1,500,000	1,700,000
North Africa and Middle East	200,000	250,000	420,000	520,000
North America	240,000	260,000	960,000	1,000,000
Oceania	5,000	7,100	28,000	34,000
South and Southeast Asia	1,800,000	2,100,000	6,400,000	7,000,000
Sub-Saharan Africa	12,800,000	13,300,000	22,500,000	23,300,000
Western and Central Europe	150,000	160,000	600,000	640,000
Total*	16,400,000	17,600,000	34,200,000	37,400,000

\*All numbers are estimates.

Now that you have examined the data and considered it in light of the background information, answer these questions. Write your answers on the back of this page.

- 1. In what three regions are women most affected by HIV, as a percentage of the population of adults living with HIV?**
- 2. In what region is the HIV infection rate among women growing the fastest, as a percentage of the population of adults living with HIV?**
- 3. If you were in charge of world AIDS policy, what would you do to slow the spread of the disease among girls and women?**



**HEADS UP  
REAL NEWS  
ABOUT DRUGS  
AND YOUR BODY**

# Trends in Teen Drug Use: Good News and Bad News



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

**In This Installment**

- Good News: Drug Use by Teens Is on the Decline
- Bad News: The Use of Some Drugs Is on the Rise
- The Dangers of Inhalants, Vicodin, and OxyContin
- How Scientists Analyze and Predict Teen Drug Use Trends

**Coming Up:**

- New Discoveries About the Brain and Addiction

**Assessment Guide**

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 abuse of inhalants and prescription drugs.

**Dear Teacher:**

There's both good and bad news about teens and drug abuse. The latest numbers are in from NIDA's annual "Monitoring the Future" survey, and they show that in the past three years there's been a record-



setting 17 percent drop in illicit drug use by students in the 8th, 10th, and 12th grades combined. This finding provides satisfying proof that efforts—by a wide range of agencies and individuals, including teachers like you—are paying off to educate teens about the risks of drug use and the disease of addiction.

Now for the bad news. The survey also found that the use of inhalants (household products, such as markers and paint thinner, whose fumes users inhale to achieve a high) has climbed among 8th-graders for the second year in a row. Also, although abuse rates for two prescription painkillers—

Vicodin® and OxyContin®—are stable, they remain high.

In this year's third installment of *Heads Up*, we present students with these findings and arm them with science-based facts about the truly frightening risks of abusing inhalants and prescription painkillers.

Research supported by NIDA has shown that students who are exposed to research-based prevention programs have lower rates of future drug use and other risky behaviors than students who aren't. With *Heads Up*, and our many other efforts, we at NIDA are working toward the day when students across the country understand the facts so well that each and every one decides not to try drugs—NOT EVEN ONCE.

Thank you for being a critical part of the battle against drug abuse and addiction among our youth—an increasingly successful effort. You are truly saving lives.

Sincerely,

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

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## Lesson Plans for Student Activities

**Preparation:** Before beginning the lessons, make two photocopies for each student of Activity 1 Reproducible “What Do You Know About Teen Drug Trends?” (page 11) as a pre-and post-assessment quiz and one copy for each student of the Activity 2 Reproducible “How Inhalant Abuse Damages the Brain” (page 12).

### Lesson 1: What Do You Know About Teen Drug Trends?

**OBJECTIVE** Students learn about teen drug use trends and the dangers of drugs whose use is rising among teens or remaining stubbornly high.

#### NATIONAL SCIENCE EDUCATION STANDARDS

Life Science; Science in Personal and Social Perspective

#### WHAT YOU WILL DO

- Before the lesson begins, hold a class discussion based on these questions: “Do you think teen drug abuse is rising or falling?” “What’s your basis for judgment?” “What do you think causes increases and decreases in the rate of teen drug abuse?”
- Tell students that they are going to determine how much

they know about teen drug use trends and three substances that teens need to be more aware of: Vicodin, OxyContin, and inhalants. Distribute copies of Student Activity 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.

- Have students read the article, “Abuse of Inhalants and Prescription Drugs: Real Dangers for Teens.” Next, hold a discussion based on these questions: “Why is it important that teens have the facts about inhalants and prescription painkillers?” “What risks do these substances pose?”

- Next, tell students it’s time to see how much they’ve increased their knowledge. Give them a second copy of Student Activity Reproducible 1. Tell them to write their names on the paper and label it No. 2. When students have finished, collect the papers and score them.
- Wrap up by discussing what students can do to keep their community free of abuse of inhalants, prescription drugs, and other drugs.

#### ANSWERS TO REPRODUCIBLE QUIZ ON PAGE 11:

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

### Lesson 2: How Inhalant Abuse Damages the Brain

**OBJECTIVE** Students use scientific data to draw conclusions about the effects of inhalants on brain functioning.

#### NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry; Science in Personal and Social Perspective

#### WHAT YOU WILL DO

- Tell students that new advances in imaging are letting scientists look directly into the living brain to figure out how and why drugs cause brain damage. Ask students how they think this capability has changed research.
- Explain that students will read about an experiment involving magnetic resonance imaging

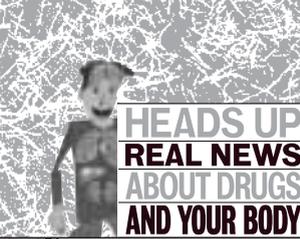
(MRI). Researchers compared the brains of solvent abusers (solvents are a type of inhalant) to the brains of cocaine abusers. The study subjects were also given cognitive tests. The researchers wanted to see how the MRI findings and cognitive test results compared in the two groups. Generate discussion about how such an experiment should be set up to ensure the results are valid. Also, ask students why it’s important to learn how particular drugs damage the brain.

- Distribute Student Activity Reproducible 2. Have students complete it.

- Wrap up the lesson by asking students: “What kind of experiment could Dr. Rosenberg conduct to find effective ways of treating solvent abusers?”

#### ANSWERS TO REPRODUCIBLE QUESTIONS ON PAGE 12:

1. The area is the white matter. The evidence is that 12 percent of solvent abusers with moderate to severe white matter abnormalities scored an average of 20 percent below the rest of the group on a verbal IQ test.
2. By drawing upon evidence that shows that parts of the brain responsible for behavior are damaged by the solvents.

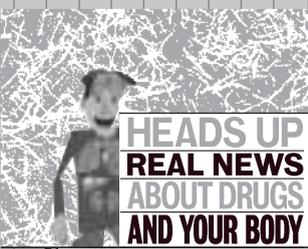


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REAL NEWS  
ABOUT DRUGS  
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## What Do You Know About Teen Drug Trends?

Test your knowledge of teen drug trends, and three substances that present a special risk for teens right now, by answering the questions below.

1. **Between 2001 and 2004, the percentage of teens in grades 8, 10, and 12 who used illicit drugs**
  - a. didn't change
  - b. rose by 10 percent
  - c. fell by 10 percent
  - d. fell by 17 percent
2. **The use of which drug recently increased among 8th-graders?**
  - a. inhalants
  - b. marijuana
  - c. Vicodin
  - d. OxyContin
3. **The 2004 "Monitoring the Future" study surveyed students in the**
  - a. 8th grade
  - b. 10th grade
  - c. 12th grade
  - d. all of the above
4. **OxyContin and Vicodin are both**
  - a. stimulants
  - b. opioids
  - c. tranquilizers
  - d. hallucinogens
5. **Which part of the body can be harmed by inhalants?**
  - a. bone marrow
  - b. nerve cells
  - c. brain
  - d. all of the above
6. **The active ingredient in many inhalants is**
  - a. aplastic anemia
  - b. water
  - c. perfume
  - d. toluene
7. **Serious health risks, including death, can occur when opiate pain medications are used**
  - a. as prescribed
  - b. without a prescription
  - c. in a form and dosage different from what a doctor prescribes
  - d. b and c
8. **Abuse of opiate pain medication can cause**
  - a. addiction
  - b. death
  - c. slowed or stopped breathing
  - d. all of the above
9. **Sudden Sniffing Death is caused by**
  - a. inhalants
  - b. Vicodin
  - c. methamphetamine
  - d. a blood-borne virus
10. **Vicodin and OxyContin are particularly dangerous when taken in combination with**
  - a. antibiotics
  - b. alcohol
  - c. vitamin C
  - d. antiviral drugs


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REAL NEWS  
ABOUT DRUGS  
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## How Inhalant Abuse Damages the Brain

Spray paint, paint thinner, and paint remover. What do they have in common? They are three very dangerous and commonly abused inhalants that contain a solvent called toluene. There is plenty of evidence that solvent abuse leads to brain damage. Many long-term solvent abusers have difficulties with coordination and walking. They also seem to suffer from lowered intelligence. Dr. Neil Rosenberg, a NIDA-sponsored scientist working at the University of Colorado Health Sciences Center, wanted to find out which parts of the brain solvents damage and how the damage correlates with loss of mental functioning. He also wanted to learn how the damage caused by solvents compares to that caused by cocaine.

### The Experiment: Solvents, Cocaine, and the Brain

**Key Questions:** How does the brain damage caused by solvents compare with that caused by cocaine? How does the amount of brain damage observed in a solvent abuser correlate with the amount of cognitive functioning lost in a cocaine user?

**Brief Description of Experiment:** Fifty-five long-term solvent abusers took a series of cognitive tests and 50 of them underwent brain magnetic resonance imaging (MRI), an imaging technique that can detect abnormalities in the brain. At the same time, 61 cocaine abusers took cognitive tests and 51 underwent brain MRIs.

### Brain Areas Studied with MRI

#### Basal Ganglia, Cerebellum, Pons, and Thalamus:

These regions play a critical role in receiving sensory information from the peripheral nervous system and the spinal cord, and relaying messages throughout the brain that control thinking, learning, movement, and other behaviors.

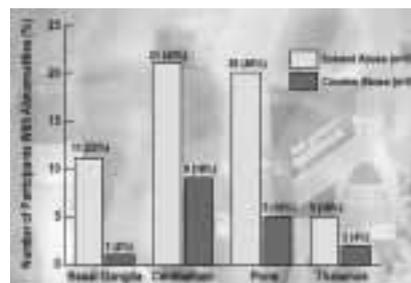
**White Matter:** White matter is an insulator for nerve fibers, allowing messages to be transmitted faster. It contains lots of neurons that are sheathed in a white fatty insulating protein called myelin.

### The Results of the Study

**Cognitive Test Results:** Both groups performed below general population averages on tests that measured short-term memory, delayed recall, and the ability to learn and make associations. Inhalant abusers, however, did worse than cocaine abusers on tests involving the ability to focus attention, plan, solve problems, and control one's behavior.

**Brain MRI Results:** The chart below shows where more frequent brain abnormalities occurred in the brains of solvent abusers than in the brains of cocaine abusers.

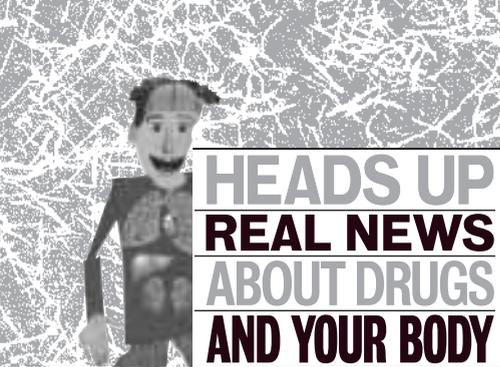
**Other Important Findings:** Solvent abusers also had more severe abnormalities in brain white matter. The solvent abusers who had more white matter abnormalities tended to have the greatest cognitive impairment. For example, 12 percent of solvent abusers who had moderate to severe white matter abnormalities (the worst damage found) scored an average of 20 percent below the rest of the group in the study on a verbal IQ test.



**Inhalant and Cocaine Abusers with Subcortical Abnormalities, by Brain Region Affected**

Read about the experiment and think about how the results work together to answer the study's initial questions. When you're finished, answer these questions. Write your answers on the back of this page.

- 1. The study shows that damage in a particular brain area plays a role in cognitive damage among solvent abusers. What is the area? What is the evidence?**
- 2. Dr. Rosenberg notes that his results show solvent abusers may be unable to "control their behavior and perceive problems associated with their substance abuse." How did he draw that conclusion?**



**HEADS UP  
REAL NEWS  
ABOUT DRUGS  
AND YOUR BODY**

# Obesity and Drug Addiction: Key Teen Health Issues



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

## In This Installment

- The Proportion of Overweight Teens Has Tripled Since 1980
- NIDA Scientists Have Uncovered a Link Between Obesity and Drug Addiction
- How Students Can Protect Themselves from Obesity and Drug Addiction
- The Facts About Being Obese

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## Assessment Guide

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 obesity and drug addiction.

## Dear Teacher:

As someone who sees adolescents every day, you are no doubt concerned that the number of teens battling health-threatening weight problems is growing. What you may not realize is that NIDA researchers are discovering fascinating connections between obesity and another key teen health issue: drug addiction.



Amazingly, drug abusers and those who suffer from obesity appear to have a similarity in brain chemistry that seems partly responsible for these compulsive behaviors.

The common link is the neurotransmitter dopamine, the brain chemical responsible for stimulating feelings of pleasure. This year's fourth and final installment of *Heads Up* discusses this link, as well as obesity research and treatment. Like all of the articles in the series this year, this one reinforces our understanding of

addiction as a brain disease—a disease that can be treated, understood, and, most important, prevented.

Learning about the seemingly unlikely link between obesity and drug addiction will give students an intricate view of how science works. It will also teach them that researchers can never know for sure where the facts will lead them. NIDA-sponsored scientists started out doing work on drug addiction but soon found themselves researching obesity, as well.

Thank you for taking time to share the lessons of *Heads Up* with your students. You have helped set the stage for a healthier, smarter, and drug-free generation of young adults.

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](http://www.drugabuse.gov/parent-teacher.html) or [www.scholastic.com/HEADSUP](http://www.scholastic.com/HEADSUP).

## Lesson Plans for Student Activities

**Preparation:** Before beginning the lessons, make two photocopies for each student of Activity 1 Reproducible “Obesity and Drug Addiction—What Do You Know?” (page 15) for a pre-text and post-text quiz and one copy for each student of Activity 2 Reproducible “Dangerous Cravings and the Brain” (page 16).

### Lesson 1: Obesity and Drug Addiction—What Do You Know?

**OBJECTIVE** To give students information about the connection between drug addiction and obesity; to increase students’ understanding of addiction and the brain; to broaden students’ understanding of the scientific process; and to assess students’ knowledge of the topics before and after reading the article

#### NATIONAL SCIENCE EDUCATION STANDARDS

Life Science; Technology; Science in Personal and Social Perspective

#### WHAT YOU WILL DO

- Before beginning the lesson, hold a class discussion based on these questions: “Are there more teens who have weight problems now than in the past?” “How big of a problem

is obesity?” “Could there be a connection between obesity and drug addiction?”

- Tell students that they are going to find out how much they know about food addiction and its connection to drug abuse. Distribute copies of Student Activity 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.
- Have students read the article, “**Obesity and Drug Addiction: The Brain Link.**” Next, hold a discussion based on these questions: “What is the connection between obesity and drug addiction?” “How can this connection help scientists understand how to treat and

prevent both conditions?”

- Next, tell students it’s time to find out how much they’ve learned. Give them a second copy of Student Activity Reproducible 1. Tell them to write their names on the paper and label it No. 2. When students have finished, collect the papers and score them.
- Wrap up the lesson by discussing the “chicken-and-egg” question from the article: “What comes first, obesity or drug addiction, or a low level of D2 receptors in the brain?”

#### ANSWERS TO REPRODUCIBLE QUIZ ON PAGE 15:

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

### Lesson 2: Dangerous Cravings and the Brain

**OBJECTIVE** Students use scientific data to draw conclusions about the effect of increasing D2 dopamine receptor levels in the brain.

#### NATIONAL SCIENCE EDUCATION STANDARDS

Science as Inquiry; Science in Personal and Social Perspective

#### WHAT YOU WILL DO

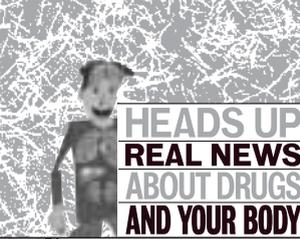
- Tell students that scientists know that D2 receptor levels are lower in people who suffer from obesity or drug or alcohol addiction. Ask students why they believe this is so.
- Explain that students will read about an experiment in which

alcohol-addicted and non-alcohol-addicted rats were medically altered to increase D2 receptor levels in their brains. The researchers compared the alcohol intake of the rats before and after the treatment. Ask students: “If increasing the D2 receptors causes the alcohol-addicted rats to stop drinking, what might be the implications for humans?”

- Distribute Student Activity Reproducible 2. Have students complete it.
- Wrap up the lesson by asking students to speculate on how this experiment and others like it might lead to useful treatments for addiction.

#### ANSWERS TO REPRODUCIBLE QUESTIONS ON PAGE 16:

1. Yes, the increase in D2 receptors led to a drop in alcohol consumption. 2. Alcohol consumption fell in both groups, but the percentage drop was larger among the alcohol-addicted rats. In the non-alcohol-preferring rats, the D2 increase almost totally abolished alcohol consumption. In the rats that preferred alcohol, it reduced alcohol consumption to the level normally seen in non-alcohol-preferring rats. 3. This was done as a control to show that it wasn’t the pressure of the needle itself but the D2 receptor gene causing the change in consumption.



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## Obesity and Drug Addiction— What Do You Know?

Test your knowledge of obesity, drug addiction, and the possible connection between the two by taking this quiz. Circle the correct answer to each question.

**1. Between 1980 and 2002, the proportion of overweight teens in the United States**

- a. didn't change.
- b. doubled.
- c. fell by half.
- d. tripled.

**2. What percentage of U.S. teens is at risk for becoming overweight or obese?**

- a. 5 percent
- b. 10 percent
- c. 15 percent
- d. 20 percent

**3. Which of the following health problems is not associated with obesity?**

- a. diabetes
- b. arthritis
- c. schizophrenia
- d. heart disease

**4. In what organ did researchers find similarities between obese people and people addicted to drugs?**

- a. stomach
- b. brain
- c. skin
- d. lungs

**5. Which natural chemical activates the brain's reward circuits?**

- a. insulin
- b. norepinephrine
- c. endorphins
- d. dopamine

**6. People addicted to drugs and obese people tend to have lower-than-normal numbers of**

- a. brain cells.
- b. D2 receptors.
- c. insulin receptors.
- d. family members.

**7. People addicted to drugs tend to have damage to a part of the brain responsible for judgment and impulse control. It is**

- a. the brain stem.
- b. the hypothalamus.
- c. the prefrontal cortex.
- d. the cerebrum.

**8. Teens with a body mass index (BMI) above the 95th percentile are considered**

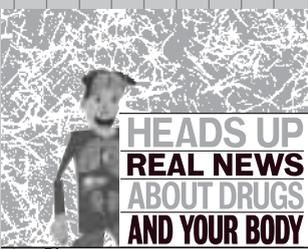
- a. underweight.
- b. normal weight.
- c. overweight.
- d. obese.

**9. Which of these boosts the number of D2 receptors in the brain?**

- a. overeating
- b. drinking alcohol
- c. reading
- d. exercise

**10. If you think you are overweight, you should**

- a. check with your doctor.
- b. buy a diet book.
- c. diet immediately.
- d. run 10 miles.



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## Dangerous Cravings and the Brain

Researchers have found that people suffering from obesity, alcohol addiction, and drug addiction tend to have lower-than-average numbers of D2 (dopamine) receptors in their brains. In 2001, researchers at Brookhaven National Laboratory in New York conducted an experiment using rats to find out if increasing the number of D2 receptors in rats' brains would decrease the amount of alcohol consumed by rats that had been trained to prefer alcohol over water. The experiment was conducted with two groups: normal rats and rats that had been trained to prefer alcohol.

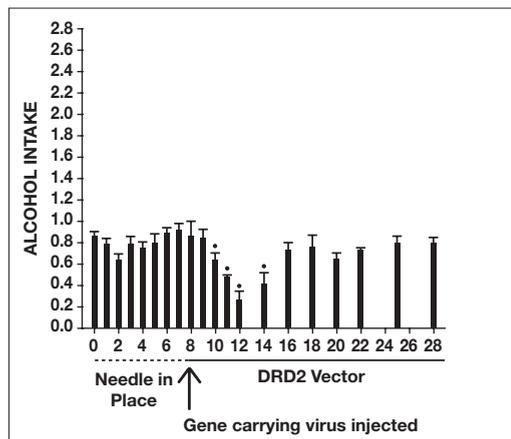
### Rats, D2 Receptors, and Alcohol Intake

**Hypothesis:** An increase in the number of D2 receptors in the brains of rats trained to prefer alcohol will make alcohol less appealing and cause them to drink less of it.

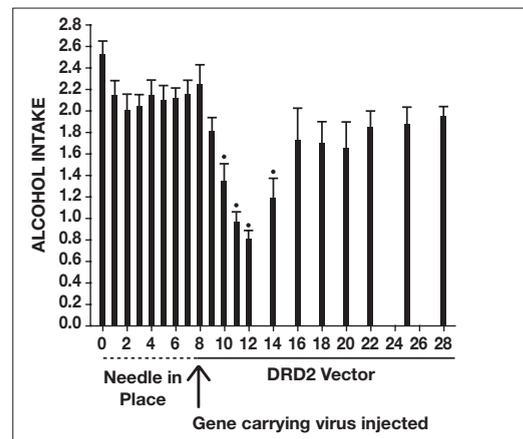
**Brief Description of Experiment:** The researchers, led by Panayotis K. Thanos, injected a virus carrying the D2 receptor gene into the nucleus accumbens (the pleasure center of the brain) of rats. This caused their brains to produce more D2 receptors. Brain imaging techniques were used to measure the increase. Of the 15 rats that received injections, six had been trained to prefer alcohol over water. (On average, 60 percent of

the liquid they chose to drink was alcohol.) Nine rats preferred water. The experiment began when the needle that would carry the gene was implanted in the rats' brains as a control. After eight days with the needle in place, the virus-carrying gene was injected. Each day, scientists measured the rats' alcohol intake. The rats could choose from two bottles: one filled with water and the other with alcohol.

### The Results of the Experiment



**Alcohol intake over time for rats that preferred water and were injected with the D2 receptor gene on Day 8.**



**Alcohol intake over time for rats that preferred alcohol and were injected with the D2 receptor gene on Day 8.**

### D2 Receptor Levels

In both alcohol-addicted and non-alcohol-addicted rats, D2 receptor levels rose—in most cases there was an approximate 50 percent increase about four days after injection of the virus-carrying gene. The D2 receptor level fell to about 8 percent above normal levels by the tenth day after the injection.

Now that you have read about the experiment, answer these questions. Write your answers on the back of this page.

- 1. Did the researchers prove their hypothesis?**
- 2. How did the results differ in the alcohol-addicted and non-alcohol-addicted rats? Are the results permanent?**
- 3. Why do you think researchers waited eight days before injecting the D2 receptor gene?**