

## Summary

This module explains how prescription drugs and some household products can damage the brain and body when used improperly. Household products are called inhalants when they are abused. These drugs are particularly prone to abuse because they are often found in the home and are easily accessible. Prescription drugs and inhalants are not dangerous when they are used as intended. However, they can lead to serious side effects, even death, when used inappropriately.

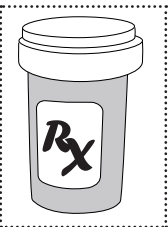
## Learning Objectives

At the end of this module:

- Students can explain the effects of prescription drugs.
- Students can explain how prescription drugs affect the functioning of the brain and body when not used properly.
- Students understand how inhalants can change the brain.
- Students understand why it is important to use medication as instructed.

## Summary

## PRESCRIPTION DRUGS



Drugs prescribed by a physician can relieve pain and control the symptoms of many disorders and diseases. People who use prescription drugs as directed by a doctor (at the prescribed dose and for the recommended length of time) are at very low risk for addiction or other negative side effects. However, intentional misuse of prescription drugs can be dangerous. Three commonly abused prescription drugs are opioids, central nervous system (CNS) depressants, and CNS stimulants.

The Internet makes prescription drugs more easily accessible for abuse. E-mail inboxes are often full of spam e-mails offering the sale of prescription drugs without a prescription. When discussing these drugs with your students, bring up the topic of dangerous and misleading spam e-mails, and how it is important to respect prescription drugs.

## Effects of Prescription Drugs on the Brain and Body

### Opioids

Opioids, such as morphine, codeine, oxycodone (Oxycontin), and hydrocodone (Vicodin), are prescribed for pain relief. Used correctly, opioids are helpful for people suffering from chronic pain or pain from surgery. These drugs act by attaching to opioid receptors in the brain and spinal cord, and blocking the transmission of pain messages to the brain. Opioids also cause initial feelings of pleasure by acting on the reward system in the brain. Side effects of opioids include drowsiness and constipation.

## CNS Depressants

CNS depressants include barbiturates and benzodiazepines (e.g., diazepam [Valium], alprazolam [Xanax], and lorazepam). These medications are prescribed to treat anxiety, tension, and sleep disorders. They slow brain function by increasing the activity of the neurotransmitter GABA. GABA decreases brain activity and causes feelings of drowsiness and calmness, which is helpful in people with anxiety or sleep disorders.

## CNS Stimulants

CNS stimulants, such as dextroamphetamine (Dexedrine) and methylphenidate (Ritalin), are prescribed for attention-deficit hyperactivity disorder (ADHD), narcolepsy (a sleeping disorder), and depression that has not responded to other treatments. Stimulants copy the activity of the neurotransmitters dopamine and norepinephrine by stimulating their specific receptors. This results in increased alertness, attention, and energy. Stimulants also result in increased feelings of pleasure, higher blood pressure and heart rate, and increased blood glucose levels.

Scientists propose that there is less dopamine transmission in the brains of persons with ADHD when compared to other individuals. Because stimulants correct this shortfall, individuals with ADHD are at low risk for becoming addicted to stimulant medications. Individuals that have not been prescribed Ritalin abuse the drug by swallowing the tablets or by crushing and then snorting them. This causes wakefulness and euphoria. In people who do not need the medication, the increased dopamine transmission caused by ingesting Ritalin can be highly addictive.

| Prescription Drug | Examples                                  | Drug Effects   |
|-------------------|---|--|
| Opioids           | Morphine, Codeine, Oxycodone, Hydrocodone | Attach to opioid receptors in the brain and body to block transmission of pain messages.   |
| CNS Depressants   | Barbiturates and Benzodiazepines          | Slow brain function by increasing the activity of the neurotransmitter GABA, which decreases brain activity and causes feelings of drowsiness and calmness. These drugs also decrease heart rate and blood pressure. |
| CNS Stimulants    | Dextroamphetamine and Methylphenidate     | Activate dopamine and norepinephrine receptors, which results in increased alertness, attention, and energy. Stimulants also cause higher blood pressure and heart rate.   |

## Prescription Drugs in Combination with Other Drugs

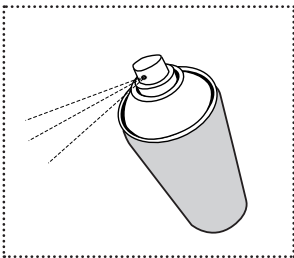
In order to be safe and healthy, patients taking prescription drugs must comply with the medication guidelines set by their doctor. It is important to know how much medicine to take, how long to take it, and what else can have an impact on its effects on the body. Possible interactions with other drugs, vitamins, certain activities, or environmental factors such as sun exposure need to be thoroughly understood by the patient for the prescribed medication. Prescription medications should never be shared.

Misusing prescription drugs can have very negative consequences. At large doses, opioids can be fatal because they can cause heart and breathing rates to slow down or stop. High doses of stimulants can cause an irregular heartbeat, seriously high body temperatures, and the potential for heart attacks and death. Taking stimulants in combination with over-the-counter cold medications can cause abnormalities in blood pressure and heart rhythm. Taking opioids and CNS depressants in combination with other drugs, such as alcohol or antihistamines, can cause severe respiratory problems and death.

## Prescription Drug Withdrawal

Long-term abuse of prescription drugs may cause addiction and produce withdrawal symptoms if the drug is discontinued. The withdrawal symptoms from prescription drug abuse vary, depending on the particular drug being abused. The withdrawal symptoms that result from opioid abuse include restlessness, insomnia, vomiting, muscle and bone pain, diarrhea, and cold flashes with goose bumps.

Withdrawal from CNS depressants may cause the brain's activity to rebound and race out of control, resulting in seizures and other harmful consequences. The withdrawal symptoms of CNS stimulants include depression, fatigue, insomnia, loss of appetite, and craving for more stimulants.



### INHALANTS

Inhalants are a class of chemicals that have many useful purposes in households but were never meant to enter the body. They are intentionally misused by sniffing or inhaling. They can be sprayed directly into the nose or mouth, inhaled from substances dropped into a bag ("bagging"), inhaled from a soaked rag ("huffing"), or inhaled from a balloon. Inhalants enter the bloodstream directly through the lungs and rapidly travel to the brain. Users experience an immediate "head rush" or high.

Many inhalants are commonly found in the home. They can be classified into four categories: volatile solvents, aerosols, gases, and nitrites.

The student materials for this module do not mention specific household products. This was intentional. Young people are often highly curious about these easily accessible drugs. To guard against such curiosity, we recommend you avoid mentioning specific products in your discussion. They are listed in the following chart for your information only.

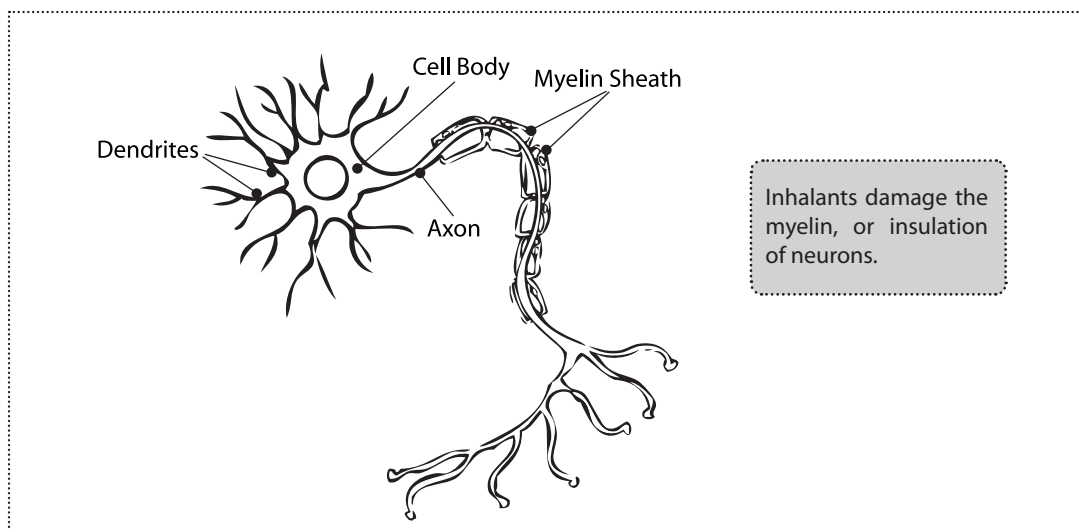
|                          |  |
|--------------------------|--|
| <b>Volatile solvents</b> | Paint thinners and removers, dry-cleaning fluids, degreasers, gasoline, glues, correction fluids, felt-tip marker fluids   |
| <b>Aerosols</b>          | Sprays containing propellants and solvents, including spray paints, deodorants and hair sprays, vegetable oil sprays for cooking, fabric protector sprays, whipped cream |
| <b>Gases</b>             | Household gases and medical anesthetics: ether, chloroform, halothane, nitrous oxide (laughing gas)  |
| <b>Nitrates</b>          | Cyclohexyl nitrite, isoamyl (amyl) nitrite, isobutyl (butyl) nitrite; sold under the name of "poppers," or found in certain room deodorizing sprays                      |

Inhalant abuse can damage areas of the brain involved in cognitive functions and produce symptoms ranging from mild impairment to dementia. Inhalant abuse can also damage brain areas responsible for movement and vision.

Permanent hearing loss and irreversible damage to nerves throughout the body can occur from using inhalants. Inhalants can cause hepatitis, liver failure, and muscle weakness. They also interfere with the production of red blood cells, which can result in a life-threatening condition known as aplastic anemia. A condition called "sudden sniffing death" may occur when inhaled fumes replace oxygen in the lungs and brain and cause suffocation. Finally, inhalants can interfere with heart rhythm, leading to a heart attack. This can occur from a single session of repeated inhalant use.

### Effects of Inhalants on the Brain

Scientists are investigating the exact way in which inhalants slow and stop the activities of neurons. Some inhalants also damage the structure of the brain, particularly the myelin, or insulation, that covers the axons. Because myelin helps messages travel through the neurons, this damage can be very serious. The parts of the brain most affected by inhalants are the cerebral cortex, cerebellum, hippocampus, and brain stem. Because of the damage to the cerebellum, heavy users of inhalants often show signs of decreased coordination, moving slowly and clumsily.



The frontal cortex of the brain, important for solving problems, and the hippocampus, a part of the brain involved in memory, are also affected by inhalant abuse. Researchers think that inhalants deprive the brain of oxygen. This causes the death of nerve cells and a decrease in nerve cell activity. Thinking, memory, and the ability to learn are all negatively affected.

Many inhalants activate the brain's reward system and stimulate the release of dopamine. This is thought to be responsible for the pleasurable feelings associated with inhalant use.

### Long-Term Inhalant Abuse

People who use inhalants over a long period of time feel a strong urge to continue using them. Effects of long-term abuse include weight loss, muscle weakness, disorientation, inattentiveness, lack of coordination, irritability, and depression.

### Preparation

- Read the Background section of this module for more information about the effects of prescription drugs and inhalants on the brain and body.
- Provide students with the Module 3 magazine *Drugs in the Cupboard* for background knowledge.
- Determine which activities you want the class to complete.
- Arrange for computer lab time or prepare the classroom computer for students' Internet and CD-ROM use.
- Photocopy and pass out the Prescription Drugs, Inhalants, and the Brain Fact Sheet for students to complete during the lecture.
- Prepare transparencies and photocopies for the lesson.
- Gather colored paper for Activity 1.

### Introduction



**Reading:** Begin by giving students adequate time to read the student magazine. Have students pay particular attention to the following sections: Background, Stats and Facts, and Science in the Spotlight.

**Time:**

15–20 minutes



**Discussion:** After students have read the magazine, facilitate a discussion about the brain using the following questions. If necessary, review this information with your students using the diagrams provided.

**Handouts:**

Module 3 magazine

**Prescription Drugs and Inhalants**

- Who should take prescription drugs? When?
- What are the three classes of prescription drugs?
- Should a person use a prescription drug that has been prescribed for someone else?
- How does inhalant abuse injure the brain and body?
- What is the name of the insulation around neurons that is damaged by inhalants?

**Handouts:**

Module 3 magazine

**Activities****Activity 1: Choose a Color****Time:**

20 minutes

**Supplies:**

Each student needs a piece of red, orange, blue, and green paper

Markers

Tell students that this is the third activity of their competition. The group that does the best job will earn five points. Remind students of which groups they are in.

Give each student four different colored pieces of paper: one for opioids, one for CNS depressants, one for stimulants, and one for inhalants. Students should label each accordingly. Read each of the statements from the next page. Pause after reading each statement and tell the students to pick the colored paper (drug) that the statement describes and to hold it up. Create your own set of paper to hold up the correct answer(s) for students to see after they have made their own selection(s).

|        |   |             |
|--------|---|-------------|
| Red    | = | Opioids     |
| Orange | = | Depressants |
| Blue   | = | Stimulants  |
| Green  | = | Inhalants   |

Warn students that sometimes they may have to hold up more than one colored piece of paper. Tell the students that if they hold up a paper with the wrong color, they will be out of the game. The game will continue until only one student is left or until all the statements have been read. If only one student is left, that student's team earns five points. If several students are left, each student earns one point for his or her team. When the game is over, record the winning group's points on the Group Scorecard.

1. These drugs should only be used when directed by a doctor.  
Answer: Red, Orange, Blue (opioids, CNS depressants, stimulants)
2. People should never use these drugs for anything other than their intended purposes.  
Answer: All colors (all four groups of drugs)
3. These drugs can cause addiction if used inappropriately.  
Answer: Red, Orange, Blue (opioids, CNS depressants, stimulants)
4. These drugs can cause death if used inappropriately.  
Answer: All colors (all four groups of drugs)
5. This group of drugs is prescribed to relieve severe pain.  
Answer: Red (opioids)
6. When one of these drugs is inhaled, it can cause sudden sniffing death.  
Answer: Green (inhalants)
7. These drugs are prescribed to patients with attention-deficit hyperactivity disorder (ADHD).  
Answer: Blue (stimulants)
8. When used inappropriately, this group of drugs can cause seizures.  
Answer: Blue (stimulants)
9. When used appropriately, this group of drugs causes calmness and helps with sleep and anxiety problems by increasing the release of the neurotransmitter GABA.  
Answer: Orange (CNS depressants)
10. When used appropriately, this group of drugs causes alertness by copying the activity of the neurotransmitters dopamine and norepinephrine.  
Answer: Blue (stimulants)
11. This type of prescription drug affects the neurotransmitter dopamine.  
Answer: Blue, Red (stimulants, opioids)
12. This group of drugs can deprive the brain of oxygen and decrease coordination.  
Answer: Green (inhalants)
13. When abused, these drugs can cause heart and breathing problems.  
Answer: All colors (all four groups of drugs)



### Activity 2: Public Service Announcement

Public Service Announcements, or PSAs, are run on TV and radio to inform the community about safety and health information. Tell the students that they will be planning, writing, and performing their own PSA for the class. Divide students into groups of 4–6, and assign each group either “prescription drugs” or “inhalants” as their topic.

Give the students about 15 minutes to look through the student magazine, their notes, and other sources to gather information concerning their assigned topic. Inform the groups that all PSAs must educate the audience on the effects these drugs have on the brain and body, and other science-based facts. Allow them another 15 minutes to plan and write their PSA; then have all groups perform their PSA. To make sure that all students in each group are actively engaged in the planning, writing, and performing of tasks, you can assign roles such as writer, director, actors, and scientific researchers.



Keep the students on track by emphasizing key lecture points about the science behind drug use from the background section.

Wrap up the activity with a discussion and assessment of the strengths of each group’s PSA.

**Time:**

40 minutes

**Supplies:**

Module 3 magazine

Pen or pencil

Paper

**Handouts:**

Prescription Drugs, Inhalants, and the Brain Fact Sheet







The CD-ROM includes games and materials to supplement the information presented in the module. The room labeled “3” contains the following activities and specific information pertaining to this module:

- **Learning Objectives:** these are presented at the beginning of each CD-ROM module
- **Pill Poppers:** an activity where students must match drug effects to the correct class of prescription drugs: depressants, stimulants, and opioids
- **Synapse Sweep:** a game in which players must act quickly to get rid of the drugs in the synapse while avoiding the neurotransmitters
- **Myelin Sleuth:** an activity where students figure out which neuron on a microscope slide is from an inhalant abuser and which is the healthy brain cell
- **Module Quiz:** this quiz is the final part of the module, intended to assess students’ learning

## Extensions

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Have students do research on ADHD using the student magazine, the Internet, and other magazines. Tell them to develop an outline summarizing ADHD: what it is, the symptoms, how common it is in children, behaviors associated with the disorder, and treatment. This will give students a better understanding of the disorder, as well as why many children take medication to treat ADHD.



Useful Web sites:

[www.nimh.nih.gov/publicat/adhd.cfm](http://www.nimh.nih.gov/publicat/adhd.cfm)

[www.help4adhd.org/en/about](http://www.help4adhd.org/en/about)

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Distribute drawing paper and drawing supplies to students. Tell them that they are going to be making a brochure for younger students (elementary age) to explain the dangers of prescription drug and inhalant abuse. Encourage students to remember what they knew about these issues or drugs when they were younger, and help them brainstorm ideas for how to present the information to the younger audience.

### Key to Icons



Art



Science



History



Business



Social Studies



English



Math

As students complete the activities in the module, observe whether they have mastered the following:

1. Do students realize the importance of taking prescription medications only under a doctor's guidance? Do they understand the effects that prescription drugs can have on the brain and body when taken improperly?
2. Do students understand the various types of prescription medications and why they are prescribed? Do they understand the possible consequences of Ritalin use for someone who doesn't have ADHD?
3. Can students explain the consequences of prescription drug use in combination with other drugs, such as alcohol, antihistamines, or other over-the-counter medications?
4. Can students list some withdrawal symptoms of inhalants? Do they understand the connection between these symptoms and how the brain changes from the use of inhalants?
5. Do students understand the short- and long-term effects of inhalants on the brain and body? Do they realize the impact of these symptoms on brain functioning?

## RESOURCES FOR TEACHERS

### National Institute on Drug Abuse (NIDA)

[www.drugabuse.gov](http://www.drugabuse.gov), 301-443-1124

This Web site contains information about drug abuse as well as sections designed specifically for parents, teachers, and students.

### Mind Over Matter Teacher's Guide

[http://teens.drugabuse.gov/mom/tg\\_intro.asp](http://teens.drugabuse.gov/mom/tg_intro.asp)

This printable/downloadable teacher's guide accompanies NIDA's Mind Over Matter series. The series is designed to educate teens about the biological effects of drug abuse on the body and brain.

### National Clearinghouse for Alcohol and Drug Information (NCADI)

<http://ncadi.samhsa.gov>, 1-800-729-6686

NCADI is the world's largest resource for information and materials concerning substance abuse. Many free publications are available here.

*Buzzed: The Straight Facts About the Most Used and Abused Drugs from Alcohol to Ecstasy.* Kuhn, C., Swartzwelder, S., and Wilson, W. New York: W. W. Norton & Company, 2003. A highly informative, detailed review of widely abused drugs.

## RESOURCES FOR STUDENTS

### Mind Over Matter

<http://teens.drugabuse.gov/mom>

Designed for teens, this site includes information about how different drugs, including inhalants and opioids, affect the brain. Also available for free by calling 1-800-729-6686.

### Free Vibe

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

Designed for teens, this site covers the risks and consequences of various drugs and provides news, advice, and real-life stories.

***Ritalin and Other Methylphenidate-Containing Drugs.*** Ferreiro, C. Philadelphia, PA: Chelsea House Publishers, 2003. Part of the “*Drugs: The Straight Facts*” series. The book provides a thorough discussion of Ritalin and ADHD, with facts about abuse.

***Inhalants.*** Lobo, I.A. Philadelphia, PA: Chelsea House Publishers, 2004. Part of the “*Drugs: The Straight Facts*” series. Provides useful information about the different types of inhalants, how they act on the brain and body, usage trends, and health effects.

***Prescription Pain Relievers.*** Foster, O.M. Philadelphia, PA: Chelsea House Publishers, 2005. Part of the “*Drugs: The Straight Facts*” series. Contains a thorough discussion of prescription pain relievers, including how they act in the brain, health effects, and usage trends. This book helps students understand the connection between these prescription pain relievers and how the brain changes as a result of the use of these substances.