

### Summary

Marijuana is the most commonly abused illegal drug in the United States. Nearly half of all high school students have used marijuana. Many children and adolescents, and even adults, think of it as a harmless drug, especially when compared to heroin, cocaine, and even cigarettes.

But marijuana is hardly harmless. Today's marijuana is 10 to 15 times stronger than it was in the 1960s. Recent research is showing that this drug has a strong physical impact on the brain and body. Because their brains are still developing, it is particularly important for young people to understand the effects of marijuana. This module is designed to teach students about the serious effects of marijuana.

### Learning Objectives

At the end of this module:

- Students can explain the short- and long-term effects of marijuana use and the seriousness of these effects.
- Students understand how THC, the active ingredient in marijuana, disrupts neurotransmission.
- Students can explain how marijuana can adversely affect the hippocampus and other parts of the brain.

## Background

### MARIJUANA



Marijuana comes from the dried leaves and flowers of the cannabis plant. It can be smoked, cooked into baked goods, or brewed into tea. It contains more than 400 chemicals. Smoking marijuana, like smoking tobacco, can have negative effects on the lungs.

Marijuana also has potentially dangerous short-term effects that can last more than 4 hours. In low to medium doses, marijuana can cause relaxation, reduced coordination, reduced blood pressure, sleepiness, attention problems, and an altered sense of time and space. In high doses, marijuana can cause hallucinations, delusions, memory problems, and disorientation.

Slang terms for marijuana include pot, herb, weed, grass, chronic, ganja, and hash.

## Marijuana and Neurotransmitters

Tetrahydrocannabinol (THC) is the active ingredient in marijuana that causes changes in the brain. THC activates specific receptors, known as cannabinoid receptors, which are located in the limbic system, cerebral cortex, and cerebellum. In student materials, cannabinoid receptors are referred to more simply as THC receptors. Because these receptors are located in many areas of the brain, the effects are widespread. In the healthy brain, cannabinoid receptors are activated by a neurotransmitter called anandamide. Anandamide is known to have a pain-relieving effect and may also play a role in numerous other brain activities. THC has many of the same effects as anandamide and can bind to the same receptors. But when THC activates the receptors, it interferes with the normal functioning of these areas of the brain.

Since the discovery of anandamide, scientists have discovered other similar neurotransmitters that also act on the receptor where THC binds. They are still investigating the function of both anandamide and these other neurotransmitters.

Marijuana also affects the neurotransmitter dopamine, which is responsible for feelings of pleasure and euphoria. This is the same neurotransmitter that is affected by alcohol, nicotine, heroin, and cocaine. Long-term use of marijuana can change the balance of these neurotransmitters.

## Effects of Marijuana

While someone is using marijuana, activity in the hippocampus is reduced, causing problems with short-term memory. Animal studies of long-term marijuana use have shown damage in this area. Research with people has found that chronic use of marijuana can cause permanent memory and cognitive problems, especially at young ages. Specifically, one study found that young people who used marijuana before the age of 17 had significantly lower verbal IQs, or the ability to think with words and process verbal information, than both people who began using the drug at an older age and people who never used it at all. These studies show that marijuana can be particularly harmful when it is used by young people when the brain is still developing.

Short-term effects of marijuana use include distorted perception, due to the drug's interference with the brain's ability to process sensory information. Information about touch, sight, sounds, and time are distorted because of marijuana's effects on the cerebral cortex. Short term marijuana use can also interfere with the normal functioning of the cerebellum. This can cause problems with balance, posture, and the coordination of movement.

Long-term use of the drug can also lead to a series of attitude and personality changes, known as "amotivational syndrome." This syndrome is characterized by a diminished ability to carry out long-term plans, a sense of apathy, decreased attention to appearance and behavior, and decreased ability to concentrate for long periods of time. These changes can also include poor performance in school.

## Marijuana Withdrawal

New research is showing that long-term marijuana use may lead to addiction. When the drug is no longer available, the user may develop an uncontrollable desire for the drug and withdrawal symptoms including decreased appetite, weight loss, disruption in sleep, increased irritability, restlessness, and anger.

## Medical Uses of THC

There are some medicines that contain THC. They are used for treating nausea and vomiting associated with chemotherapy for cancer treatment, and for improving appetite which is one of the complications of AIDS.

Although THC can be very helpful to people suffering from cancer, and AIDS, it continues to have negative side effects. Scientists are studying the drug so that they can develop a therapeutic drug that is free of THC's negative consequences. Another chemical related to THC, nabilone, has been approved by the U.S. Food and Drug Administration for treating nausea associated with cancer treatment. Research in this important area continues.

## Preparation

- Read the Background section of this module for more information about the effects of marijuana on the brain and body.
- Provide students with the Module 4 magazine *Weeding Out the Grass* for background knowledge.
- Determine which activities you want the class to complete.
- Photocopy and pass out the Marijuana Fact Sheet for students to complete during the lecture.
- Arrange for computer lab time or prepare the classroom computer for students' Internet and CD-ROM use.
- Pass out copies of the Marijuana Survey **a few days ahead of time**. Give each student 2–3 copies and instruct them to have some friends fill them out anonymously. Tell them not to look at the papers in respect of their friends' privacy. Collect the surveys prior to the class period you plan to teach this lesson and tally up the responses.

The introductory activity requires a few days preparation.

Begin by announcing the results of the survey, and see if the class is surprised. Tell them they are going to learn more about the drug in today's class.



**Reading:** Give 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.



**Discussion:** After students have read the magazine, facilitate a discussion about marijuana using the following questions.

**Time:**

15–20 minutes

**Handouts:**

Module 4 magazine

### **Marijuana:**

- What is marijuana? Where does it come from?
- What effects does marijuana have on a person?
- How does marijuana affect neurotransmission?
- Can an individual become addicted to marijuana?

At the end of the discussion, ask the class whether they feel their friends have an accurate view of marijuana. Help them understand how common opinions can contradict science.

## Activities



### **Activity 1: Marijuana Bingo**

Tell students that this is the fourth activity of their competition. The group who gets a bingo first earns 5 competition points. Instruct the students to sit with their *Brain Power! Challenge* groups; however, explain to them that, for this activity, they will participate individually and each play their own card. Only one person in the group is required to get a bingo for the team to earn the 5 points.

1. Pass out a bingo card to each student. Using the word bank at the bottom of the card, instruct students to write a word in each of the spaces on the card. Each word should only be used once.
2. Using the teacher bingo sheet, read each definition in order always announcing the number first because this is how the students will mark their cards. For example: Number 1—The active chemical in marijuana. At this time, instruct students to find the answer on their cards and

**Time:**

30 minutes

**Supplies:**

Bingo cards

Teacher bingo sheet

Markers

mark with a “1.” Continue reading the definitions in order, reminding students to mark the answer with the definition’s number, until someone yells, “Bingo”. Inform the students that they need to get 5 in a row—diagonally, across, or up and down. Other bingo patterns can be substituted if you choose to do so.

3. Use the teacher bingo sheet to check for correct answers. Marked words should correspond with definition numbers. If the player gets all answers correct, that team earns 5 points. If any of the answers are wrong, the game continues until someone wins.
4. Record the team points on the Group Scorecard.



**Activity 2: Poster Presentation**

In the 1960s, some people thought that marijuana was a “safe” drug. However, new research presents a different picture of this drug. During this activity, students have an opportunity to find out for themselves the latest research on the effects of marijuana on the body and brain.

Divide the class into groups of three or four students. Ask each group to imagine that it has been asked to present the latest research on marijuana at a National medical conference. Have students use the Fact Sheet, CD-ROM, student magazine, and the Web sites listed on the next page to:

1. Study current research about marijuana.
2. Create a scientific poster presenting findings from the research. The poster should include statistics about marijuana use, results of recent research, charts and graphs providing important information, and any other relevant findings.
3. Have each group present its findings to the class.
4. After all groups have presented, brainstorm as a class different ways of educating the general public about the latest marijuana research.

**Time:**

45 minutes, or adequate research and presentation time (may want to allow more time for poster preparation)

**Supplies:**

- CD-ROM
- Module 4 magazine
- Computer for research
- Poster board
- Additional art supplies as desired

**Handouts:**

- Marijuana Fact Sheet



Prior to activity, add these sites to the classroom computer's "Favorites" drop-down menu.

[www.nida.nih.gov/drugpages/Marijuana.html](http://www.nida.nih.gov/drugpages/Marijuana.html)

[www.theantidrug.com/drug\\_info/drug\\_info\\_truth\\_facts.asp](http://www.theantidrug.com/drug_info/drug_info_truth_facts.asp)

[www.freevibe.com/Drug\\_Facts/marijuana.asp](http://www.freevibe.com/Drug_Facts/marijuana.asp)

[www.whitehousedrugpolicy.gov/publications/pdf/mj\\_rev.pdf](http://www.whitehousedrugpolicy.gov/publications/pdf/mj_rev.pdf)

[http://teens.drugabuse.gov/mom/mom\\_mj1.asp](http://teens.drugabuse.gov/mom/mom_mj1.asp)



The CD-ROM includes games and materials to supplement the information presented in the module. The room labeled "4" contains the following activities and specific information pertaining to this module:

- **Learning Objectives:** these are presented at the beginning of each CD-ROM module
- **Using Animals in Research:** a short lesson on the ethical use of animals and research, and why this use is scientifically important
- **Rat Trap:** a fun game where players scramble to capture rats and return them to their cages
- **Receptor Search:** students learn where THC receptors are located in the brain, through an interactive game
- **Experiment: Marijuana and Memory:** students will conduct a full experiment to learn the effects marijuana has on memory
- **Module Quiz:** this quiz is the final part of the module, intended to assess students' learning

1.  Have students develop a public relations campaign against marijuana use. Refer them to [www.abovetheinfluence.com](http://www.abovetheinfluence.com) as an example. They can develop posters to put around the school as well as announcements to be delivered over the PA system. If the school has a TV station, students could develop a short announcement to be broadcast on the school's news program. Have students set a timeframe that the campaign will run and a goal for its outcome.
2.  Have students develop a PowerPoint® presentation on the effects of marijuana on the body and the brain. The presentation could include illustrations of the brain, charts and graphs, and relevant statistics.
3.  Have students keep a "log" of when and where they see mention of marijuana in popular media. Ask them to cut out or copy newspaper magazine articles, and keep a record of when they notice references to the drug on television. Ask them to think about the differences between how the drug is represented, and what science can tell us about the effects of drugs on the brain and body.

Key to Icons



Art



Science



History



Business



Social Studies



English



Math

Assessment

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

1. Can students explain the effects of marijuana on the brain and how these effects can change the brain?
2. Do students understand the scientific basis for the laws making marijuana use illegal?
3. Do students understand how marijuana affects neurotransmission?
4. Did students participate in the class activities and discussion? Did they engage in the topics?

## 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 a section designed specifically for parents, teachers, and students.

### 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.

### 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. Also available for free by calling 1-800-729-6686.

*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

### NIDA for Teens

<http://teens.drugabuse.gov>

Designed for teens, this site provides information on several drugs, including marijuana, as well as quizzes and real-life stories.

### Mind Over Matter

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

Designed for teens, this site includes information about how different drugs, including marijuana, 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.

### Above the Influence

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

Designed for teens, this site focuses specifically on marijuana and the influences surrounding teens and this drug.

*Marijuana.* Mehling, R. Philadelphia, PA: Chelsea House Publishers, 2003. Part of the "Drugs: The Straight Facts" series. Contains a thorough discussion of marijuana, including how it acts in the brain, history, health effects, usage trends, and relevant laws.