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*Teacher Resources from the*
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# Calculating Risk

Activity from *Brain Chemistry: Teacher's Guide*

by

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**"The brain is the last and grandest biological frontier, the most complex thing we have yet discovered in our universe. It contains hundreds of billions of cells interlinked through trillions of connections. The brain boggles the mind."**

James D. Watson
from Discovering the Brain
National Academy Press, 1992

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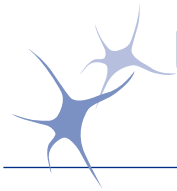
# Calculating Risk

People perceive risks differently, depending on the nature of the risk and their individual experiences. Risk perceptions are strongly influenced by issues of choice and control; risks often seem "riskier" to people if they have not voluntarily chosen to bear them. Conversely, people are more willing to accept or ignore risks that they choose voluntarily, especially if the immediate benefit seems to outweigh the potential for negative outcomes much later in time. In the case of chemical substances that affect the brain, the risks can be very high indeed.



## Unit Links

**LEGACY OF LOST CANYON**

Story, Chapter 10.

**EXPLORATIONS**

Careers for NeuroExplorers, p. 6; and How Risky Is It?, p. 8.

It is important to note that most people begin to use brain-altering chemicals voluntary. Over time, however, the brain and body adapt to the effects of the chemical. This creates a new "normal" state, adjusted to the presence of the introduced substance. Such adaptation leads to a physical dependence, or "craving," for the substance that is no longer voluntary and may lead to consumption of the substance in increasingly higher and more damaging amounts.

For example, more than 80 percent of the current US population chooses to consume the stimulant caffeine in coffee and/or cola drinks because of its taste and/or perceived enhancement of mental and physical performance. Eventually, most caffeine consumers develop a dependence on its stimulating effects and experience mild withdrawal symptoms, such as sleepiness and headaches, when they do not have caffeine. Other chemicals have more dramatic effects on the brain and body. Many affect the parts of the brain responsible for generating the feeling of pleasure or well-being. However, feelings of euphoria, comfort or pleasure usually disappear after the first few uses of the substance.

Drugs that act on areas of the brain related to sensations of pleasure are sometimes used inappropriately by people to change the way they feel. Unfortunately, continued drug use actually changes the way the brain works. This is the biological basis of addiction.

Many mind-altering chemicals that are abused by children and

## OVERVIEW

Students will estimate risks associated with different events and compare their estimates to the real probabilities.

## CONCEPTS

- Perception of risk is affected by issues of personal choice and control.
- Many chemicals influence the function of the brain and nervous system.
- Health risks associated with tobacco, alcohol and other drugs of abuse often are underestimated.

## SCIENCE & MATH SKILLS

Predicting, sorting and classifying, comparing, sequencing, inferring and understanding probability

## TIME

**Preparation:** 10 minutes
**Class:** 45 minutes

## MATERIALS

Each group will need:

- roll of clear tape, 0.5 in.

Each student will need:

- pair of scissors
- sheet of paper, 8.5 x 11 in.
- copy of What Are the Odds? and The Risks Are Real student sheets

## Chemicals for Better Health

Studies on how chemical messengers work within the brain and nervous system hold promise for unraveling many basic questions about the actions of drugs and the causes of some diseases. Almost all drugs that influence the way the brain works do so by altering the transmission of chemical messages. This influence can have important medical applications for the treatment of severe pain or illnesses such as schizophrenia or depression. Some medicines used to treat depression, for example, act on chemical messengers involved in regulating sleep and body temperature. Morphine, a potent pain medication, mimics the effects of a natural chemical messenger that works along brain pathways for minimizing pain and producing a sense of well-being.

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Anthropologists have uncovered ancient uses of mind-altering substances for medicinal and ritualistic uses in a number of cultures around the world.

The use of the substances in ritualistic practices was strictly controlled by community leaders and involved plant-based medicines that were less potent and less refined than many of the drugs used today.

adults in the US lead to permanent changes in the brain and other parts of the body. Marijuana use can alter memory regions of the brain and affect coordination and the senses in the short term. Heroin changes the way nerve cells in the brain receive and process messages. Inhalants, which are taken up by fatty tissue in the body, destroy the fat-containing myelin sheath on nerve cell axons and block nervous system communications, sometimes permanently. LSD can contribute to the development of chronic mental disorders. Alcohol, which depresses physical and mental abilities, damages many tissues throughout the body, including the liver and the brain. Alcohol also is a major contributing factor to automobile accidents because it affects coordination and judgment. Nicotine, a stimulant in tobacco, is a very addictive substance that can damage the circulatory system. However, the greatest health risk from smoking comes from other compounds in cigarette and cigar smoke that are linked to development of lung and other cancers.

### SETUP

Begin with a class discussion, followed by students working in groups of four to complete the activity.

### PROCEDURE

1. Begin with a class discussion of the previous activity in which students simulated the effects of chemicals on neuron signaling. Ask, *What are examples of substances that change the way the brain works or how a person feels?* Give students time to think of some of the most common examples, such as alcohol, coffee and soft drinks with caffeine, cigarettes (nicotine), marijuana, inhalants ("sniffing" glue, paint or aerosols), etc.
2. Follow by asking, *Do you think people evaluate possible health risks when they take a substance that affects the brain? Why or why not?*
3. Tell students that one way to quantify risk is to state it as a probability that something will occur. For example, when students rolled a die in Activity 4, they had a one in six chance of rolling a "two" on any given toss because the die has six sides. Explain that by studying how frequently events have happened in the past, scientists and statisticians have been able to calculate the risk of many different types of occurrences.
4. Give each group of students a copy of the What Are the

Odds? student sheet and have them read all of the statements. Have students cut the statements into strips (so that they can be rearranged easily). Next, have students discuss within their groups how likely it is that each event will occur.

5. Students should rank the events numerically, from most likely to occur to least likely. The number "1" should be given to the most likely event. Have students place the strips in order of likelihood from most risk (top) to least risk (bottom). You may want to provide tape and a separate sheet on which students can arrange and secure their strips.

   **Note.** Tell students that some items have the same odds.
6. Discuss students' predictions briefly by asking which events they placed at the tops and bottoms of their lists. Let each group share some of its predictions and the reasoning behind the choices. Allow student groups to rethink or revise their predictions based on the discussion.
7. Distribute a copy of The Risks Are Real student sheet to each group and ask students to compare their predictions to the actual risk calculations.
8. Conclude by discussing the actual risks as compared to students' predictions. Ask guiding questions such as, *Which ranking surprised you the most? Which were you able to predict most accurately? Do you think you or any of your friends might be ignoring long-term risks because you are making choices based on short term benefits?*

## Abuse or Addiction?

There is a difference between drug abuse and drug addiction. Drug abuse is a voluntary activity: the user makes a choice about taking a harmful drug. Drug addiction is a compulsion: the need to use a drug is overwhelming.

People abuse drugs because the drugs produce feelings of pleasure, or because they remove feelings of stress and emotional pain.

Over time, the body can become "used" to an addictive drug, causing severe withdrawal symptoms when the substance is removed. Addicted people continue drug use to avoid the pain of withdrawal, not because they derive any pleasure from the experience.

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Drug addiction and abuse is one of the most serious problems of our modern society. There are more than 10 million alcoholics in the United States. About 5.5 million people in the United States are addicted to illegal drugs.

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Eighty percent of all people who have completed drug treatment programs relapse within six months.

# What Are the Odds?

Read the statements below. Cut the statements into strips and place the events in order from most likely (top) to least likely to occur (bottom). Rank the statements numerically, assigning "1" to the most likely event. Keep in mind that some items are equally likely, so they will share the same number.

Being born left-handed

Living to the age of 116 years

Being killed by a shark

Picking all 5 winning numbers in a lottery (total of 49 numbers)

Quitting smoking successfully without any help

Becoming addicted to caffeine if you regularly drink caffeinated coffee, tea or soft drinks (such as cola)

Being electrocuted

Becoming a professional basketball player if you play basketball in high school

Becoming addicted to nicotine if you smoke cigarettes

Being involved in an alcohol-related car accident

Having poor driving skills after smoking one marijuana cigarette

Being killed by falling out of bed

Permanently damaging the myelin sheath on nerve cells in the brain by "sniffing" paint or glue

Dying from influenza (the flu)

Being pressured by a friend to smoke or use alcohol

Having a fatal accident while playing sports

Becoming dependent on crack or cocaine, if injected

Dying of a smoking-related illness if you start smoking as a teenager

# The Risks Are Real

These are the real odds for the events you ranked, from most likely to occur to least likely. Compare the odds to your rankings. Surprised?

| | | |
|---|---|---|
| **1.** | Having poor driving skills after smoking one marijuana cigarette | 1 in 1 |
| **2.** | Becoming addicted to caffeine if you regularly drink caffeinated coffee, tea or soft drinks (such as cola) | 1 in 1.25 |
| **3.** | Becoming addicted to nicotine if you smoke cigarettes | 1 in 2 |
| **3.** | Permanently damaging the myelin sheath on nerve cells in the brain by "sniffing" paint or glue | 1 in 2 |
| **4.** | Being pressured by a friend to smoke or use alcohol | 1 in 3 |
| **4.** | Being involved in an alcohol-related car accident | 1 in 3 |
| **4.** | Dying of a smoking-related illness if you start smoking as a teenager | 1 in 3 |
| **5.** | Becoming dependent on crack or cocaine, if injected | 1 in 4 |
| **6.** | Being born left-handed | 1 in 5 |
| **7.** | Quitting smoking successfully without any help | 1 in 10 |
| **8.** | Dying from influenza (the flu) | 1 in 5,000 |
| **9.** | Becoming a professional basketball player if you play basketball in high school | 1 in 10,000 |
| **10.** | Having a fatal accident while playing sports | 1 in 25,000 |
| **11.** | Being electrocuted | 1 in 350,000 |
| **12.** | Picking all 5 winning numbers in a lottery (total of 49 numbers) | 1 in 1,953,393 |
| **13.** | Being killed by falling out of bed | 1 in 2 million |
| **14.** | Being killed by a shark | 1 in 300 million |
| **15.** | Living to the age of 116 years | 1 in 2 billion |

Compiled from public domain statistics made available by the National Institutes of Health, Center for Substance Abuse Prevention, National Clearing House for Alcohol and Drug Information, American Cancer Society, CareerQuest and Dartmouth University.