HOW DO **GENES** AFFECT **ADDICTION?**

Experts in genetics are discovering how genes can affect a person's risk of becoming addicted to drugs or alcohol. Their studies could help prevent and treat this illness.

Why do some people become addicted to alcohol, tobacco, or other drugs while others do not? Scientists are trying to answer that important—and complex—question.

There are many factors that affect a person's risk for addiction. **Environmental factors** are things like stress, peer pressure, and family relationships. Examples of **biological factors** are age, gender, and a person's **genes**.

Genes are segments of DNA. They are passed down from parent to child. Researchers are studying the link between genes and addiction. They hope to learn how to better prevent and treat this illness.

Genes and Heredity

All of your traits are influenced by your genes. Traits are things like hair color and eyesight. Genes contain instructions for making proteins. These proteins are used to build the body's cells. They also direct all of the activities inside your cells.

Genes can have different forms, called **variants**. Slight differences between variants cause unique features, such as blue eyes versus brown. You inherit genes from your parents. That's why family members usually share similar traits.

Scientists have now identified some genes that are linked to addiction. Certain gene variants occur more often in people with alcohol or drug addictions.

This means that a person who has a high-risk gene variant is at a greater risk for developing an addiction than someone who doesn't. So, people with a family history of addiction may be at a greater risk for becoming addicted. However, genes alone do not determine whether or not a person will develop an addiction.

Risk Doesn't Equal Addiction

Most people with high-risk genes will not become addicted to alcohol or drugs. Likewise, a person without a genetic risk can still become addicted. Scientists estimate that genes make up about half of a person's chance of developing an addiction.

Other factors include:

- **Risk factors,** such as experimenting with drugs during adolescence when the brain is still developing. Risk factors can increase a person's chances.

- **Protective factors,** such as having strong friendships and strong family relationships. Protective factors can decrease a person's chances.

People can help keep themselves safe by increasing protective factors and reducing risk factors.

Age: An Important Risk Factor

One of the most important risk factors for addiction is age.

The brain continues to develop until a person's early to mid-twenties. It is much more sensitive to addictive substances while it is developing. Studies have shown that addiction is also much more likely in people who start using alcohol or drugs in their teens.

Decrease your risk of addiction. Protect your brain from addictive substances while it is developing.

FUTURE TREATMENTS

Scientists are studying how a specific gene affects the brain's response to alcohol or drugs. They hope to improve how we prevent and treat addiction.
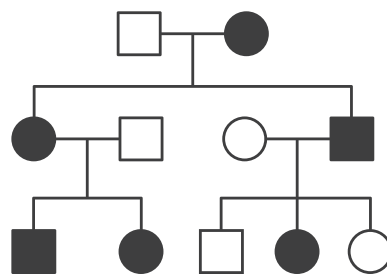
Nicotine is the addictive drug in cigarettes and vaporizing devices such as e-cigarettes. Researchers have discovered genes that affect how nicotine changes brain activities, such as attention, appetite, and habit formation. Occasional smokers who have high-risk variants of genes that control nicotine's effects are more likely to transition to regular use and nicotine addiction.

This information helps lead to better treatments. Medications used to treat addiction have helped people with high-risk nicotine genes. In the future, scientists hope to develop new medications that reverse the effects of high-risk genes.
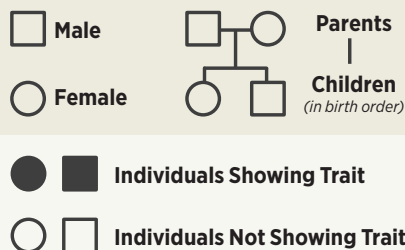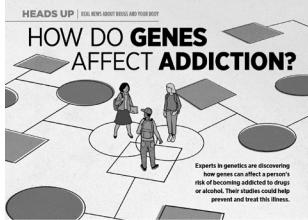
TRACKING GENES

A **pedigree** (example at right) is a diagram used to study family traits. Scientists may use pedigrees to study the way genes influence addiction.

Symbols, lines, and colors represent people, family connections, and traits. A repeating trait could show the influence of genes.

KEY:

☐ **Male**

◯ **Female**

Parents

Children *(in birth order)*

● ■ **Individuals Showing Trait**

◯ ☐ **Individuals Not Showing Trait**

HEADS UP
REAL NEWS ABOUT DRUGS AND YOUR BODY

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HEADS UP | REAL NEWS ABOUT DRUGS AND YOUR BODY

HOW DO GENES AFFECT ADDICTION?

How Do Genes Affect Addiction? NIH National Institute on Drug Abuse

One of the keys to preventing negative consequences of drug and alcohol use is determining what puts people at risk for addiction. In the article "How Do Genes Affect Addiction?," students will learn about the role of genetics in a person's risk for addiction, as well as learn that genetics isn't the only factor that influences the risk. Many other biological and environmental factors play a role, and students will get tips about choices they can make to reduce their risk. By sharing the article and skills sheet (see reverse side) with your students, and teaching the lesson below, you can help them understand the risks and how to stay safe.

Subject

• Science Literacy
• English Language Arts
• Health/Life Skills

Common Core State Standards

RST.6-8.1 / RST.9-10.1
• Cite specific textual evidence to support analysis of science and technical texts
W.6-8.1 / W.9-10.1
• Write arguments to support claims, using valid reasoning and relevant and sufficient evidence

Next Generation Science Standards

MS-LS3.A / HS-LS3.A
• Inheritance of Traits
MS-LS3.B / HS-LS3.B
• Variation of Traits

National Science Education Standards

• Reproduction and Heredity
• Personal Health

National Council for the Social Studies

• 4. Individual Development and Identity
• 8. Science, Technology, and Society

Additional Teaching Resources:

• **headsup.scholastic.com /teachers**
• **teens.drugabuse.gov**

Critical-Thinking Questions

1) How might genetics help prevent or treat addiction in the future? *(Answers may include that scientists may one day develop medications that reverse the effects of high-risk genes. People who may have high-risk genes could be provided with counseling or take actions to increase protective factors.)*

2) Do you think there is a single "addiction gene" that determines if someone will become addicted to drugs? Why or why not? *(Answers may include that it is unlikely that a single addiction gene exists. Besides genes, there are many factors that determine a person's risk for becoming addicted to drugs.)*

3) Why is it important to understand the risk factors for addiction? *(Answers may include that knowing the risks may help people actively reduce their risk factors and boost their protective factors.)*

Writing Prompts

• **Grades 6–8:** Explain how genes could increase a person's risk for addiction.

• **Grades 9–10:** What is one reason genetics research is important in understanding addiction? Use evidence from the text to support your answer.

• **Grades 11–12:** What might a person do to decrease his or her risk for addiction?

Vocabulary Tools:

Visit **scholastic.com/headsup/teachers /how_do_genes_affect_addiction** for a vocabulary list to support the student article and lesson.

Student Skills Sheet

The worksheet on the reverse side provides students with information about some of the different factors that can affect a person's risk for addiction and asks critical-thinking questions about the information. Possible answers include:

1. A protective factor is something that reduces the risk for addiction, such as strong family bonds or having friends who don't use drugs. A risk factor is something that increases a person's risk, such as a family history of addiction or a lack of parental support. (Examples are found in the table.)

2. A person with no family history of addiction and strong family bonds can still develop an addiction. Many factors can come into play, and every person is unique.

3. A person can reduce his or her risk by increasing the number of protective factors in his or her life. Some examples are: spending time with friends who are a good influence and don't use drugs; not taking drugs at a young age; and getting involved in after-school activities.

Interactive Activity

• "PI: Pedigree Investigator, On the Case of Nicotine Addiction" (**learn.genetics.utah.edu/content /addiction/pi/**)

This activity gives more information about how pedigrees are constructed and has students complete one to see how nicotine addiction runs in a family.

• **Writing Prompt:** Does the family described in the activity support the theory that genes affect nicotine addiction? Explain how using a pedigree helped you reach your answer.

WHAT AFFECTS THE RISK FOR ADDICTION?

Many factors can increase—and decrease—a person's risk for becoming addicted to alcohol, tobacco, or other drugs.

Risk factors can increase the chance of addiction. They include biological factors, such as certain genetic variants, and environmental factors, such as friends who use drugs.

Protective factors can decrease the risk for addiction. They include strong family bonds or friends who are a good influence.

A person with more risk factors and fewer protective factors usually has a greater chance for addiction. However, a person with few risk factors can still become addicted. And most people who are at high risk never become addicted. Study the table to the right to learn some risk and protective factors for addiction.

Directions: *Study the table. Then use this information along with facts from the article "How Do Genes Affect Addiction?" to answer the questions at the bottom of the page. Write your answers on separate paper.*

Risk and Protective Factors for Addiction

⚠ RISK FACTORS	⊕ PROTECTIVE FACTORS
• Family history of addiction	• Strong family bonds
• Lack of parental support	• Parental involvement
• Lack of strong family bonds	• Friends who are a good influence and don't do drugs
• Friends or family who use alcohol, tobacco, or drugs	• Strong community
• Availability of drugs	• Anti-drug policies at home and in school
• Drug use during adolescence	• Strong school performance
• Mental health problems such as depression	• Participation in after-school activities
• Stress	• Having strategies to cope with stress
• High-risk gene variant	• Low-risk gene variant
• Exposure to trauma or violence	

QUESTIONS:

1. Explain the difference between a protective factor and a risk factor for addiction. Give one example of each.

2. Suppose a person has no family history of drug addiction and has strong bonds with his or her parents. Is it guaranteed that the person will not develop an addiction? Support your answer with evidence from the text.

3. Suppose a person has a strong genetic history of addiction. Give three ways the person can reduce his or her own risk.

VOCABULARY LIST
GRADES 6–12

Dear Teacher,

The vocabulary list on the following pages is drawn from the "Do Genes Cause Addiction?" student article and "Who Is at Risk?" work sheet.

This vocabulary can be previewed with students prior to reading or reinforced with students afterward. Encourage students to incorporate these words into their writing and discussion of both the article and the work sheet.

The vocabulary list integrates two different tiers of vocabulary words that would be used across several content areas,

Supplement for: "How Do Genes Affect Addiction?"

- Student Article: **scholastic.com /headsup/how_do_genes_affect _addiction**

- Teacher's Guide (includes work sheet): **scholastic.com/how_do_genes _affect_addiction**

such as *distinct*, *manipulate*, and *susceptible*, and domain-specific words, such as *DNA*, *gene*, and *protein*.

Some suggestions for students to help their understanding:

- organize concept maps that include word parts, synonyms, antonyms, and examples;
- compose memory aids that explain the words or use them in a meaningful context;
- employ the words to create newspaper articles, stories, or poems.

Sources: Unless otherwise noted, definitions below are sourced or adapted from *Merriam-Webster's Collegiate dictionary* and *Scholastic Children's Dictionary*

activate *(verb)*: to make active or more active

addicted *(adjective)*: having a compulsive (uncontrollable) behavior, such as drug use, that continues despite negative consequences

addiction *(noun)*: a brain disorder or illness associated with compulsive (uncontrollable) behavior, such as drug use, despite negative consequences

addictive *(adjective)*: something, such as a drug, that causes changes to the brain that result in compulsive (uncontrollable) behavior despite negative consequences

adolescence *(noun)*: the period of life when a child develops into an adult

analyze *(verb)*: to study or examine something closely or carefully in order to understand it

bind *(verb)*: to attach to something

biological *(adjective)*: of or having to do with living things and their processes

cell *(noun)*: the smallest unit that makes up a living organism. Some organisms are made of only one cell, but others, like humans, are made of trillions of cells.

characteristic *(noun)*: a quality or trait that exists in a person, group, or thing

develop *(verb)*: to grow or cause something to become larger or more advanced

distinct *(adjective)*: different or separate

DNA *(noun)*: the molecule found in cells that carries instructions for cell structure and processes in the body. DNA contains genes that are passed on from parents to offspring and gives living things their inherited characteristics. The letters DNA stand for deoxyribonucleic acid.

environmental *(adjective)*: of or having to do with the objects and conditions in a set of surroundings

factor *(noun)*: something that helps to cause a result

gene *(noun)*: a small section of DNA that contains the instructions for making a protein or proteins that control the processes that occur in the body's cells.

genetic *(adjective)*: relating to, caused by, or controlled by genes

genetics *(noun)*: the genetic makeup of an organism, a group of organisms, or a condition. Also, the scientific study of the ways that personal characteristics are passed from one generation to another through genes.

hereditary *(adjective)*: passed on or able to be passed on from parent to offspring through genes

heredity *(noun)*: the process by which genes and traits are passed from parent to offspring

influence *(verb)*: to affect or change the properties or development of something

inherit *(verb)*: to receive from a parent through the transmission (passing on) of genes

interact *(verb)*: to act upon one another

likelihood *(noun)*: probability of occurring

makeup *(noun)*: the way in which the parts of something are put together

manipulate *(verb)*: to control, use, or change something in a skillful way

nicotine *(noun)*: the addictive chemical found in tobacco

pedigree *(noun)*: the history of a family's genes or traits. Pedigrees are represented in a chart and indicate how traits are passed on from parent to offspring.

potentially *(adverb)*: possible; being able to occur or develop

prevent *(verb)*: to stop from happening

protective *(adjective)*: providing a shield or cover from harm or damage

protein *(noun)*: a substance found in all living things that is made of amino acids, which are composed mainly of nitrogen, carbon, oxygen, and hydrogen. Proteins have specific functions and are involved in nearly all important cell processes.

reduce *(verb)*: to make smaller in size, amount, or number

risk *(noun)*: the possibility of loss or injury; danger

segment *(noun)*: one of the parts into which something is divided

slight *(adjective)*: small

strategy *(noun)*: a plan or method for reaching a certain goal

substance *(noun)*: a material with a specific chemical makeup

supervision *(noun)*: the action of watching over and directing something or someone

susceptible *(adjective):* open or particularly prone to something

trait *(noun)*: a quality or characteristic that makes one person different over another.

transition *(noun)*: a change from one state, stage, or place to another

variant *(noun)*: something that shows a difference from other things of the same type

vulnerability *(noun):* the state of being exposed or open to danger or harm