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Dear Teacher:

The latest *Heads Up* installment highlights addiction science research that may help students think differently about the lasting effects of abusing methamphetamine and smoking cigarettes, and about *who* can conduct research.

The student article focuses on two unusual research projects conducted by three teens, all honored with a 2009 Intel ISEF Addiction Science Award.

The student worksheet profiles the research of a scientist who used functional Magnetic Resonance Imaging (fMRI) to scan the brains of adults and adolescents to better understand why adolescents make risky decisions.

These accounts illustrate how scientists—whether teens or trained professionals—use the scientific method to answer

questions about drug abuse. We hope that by sharing these materials with your students, you will encourage them to do the same.



Nora D. Volkow, M.D.
 Director,
 National Institute on Drug Abuse

In this Installment:

- **Student article:** Reports on the remarkable research of the teen winners of the 2009 Intel ISEF Addiction Science Awards
- **Student worksheet:** Reports on how teen brains and adult brains differ when making decisions

TSI: Teen Science Investigations

Lesson Overview: The student article and this accompanying lesson/student worksheet are to be used together to highlight how scientists use the scientific method to find answers to questions. Below, you'll find questions to engage students and help them comprehend both the article and the worksheet.

Alignment with National Science Education Standards (NSES)

- *Science as Inquiry:* Having abilities necessary to do scientific inquiry; understanding scientific inquiry
- *Science in Personal and Social Perspectives:* Risks and benefits

Student Article:

Before-Reading Discussion:

- Have you ever had a question about the lasting effects of drugs on the body? How might drug abuse affect the environment? How would you go about finding the answers?
- How do you think scientists find answers to their questions about drug abuse?

After-Reading Discussion:

- What surprised you most about the research that the teen scientists conducted?
- After reading about their findings, do you think differently about the health risks of abusing methamphetamine? About smoking cigarettes and about cigarette smoke?

Writing Prompt:

- The teen scientists profiled in the article were inspired to ask questions after learning something that surprised them. Have students come up with their own research questions based on something they have heard or read in a news report. What inspired their questions? How might they design an experiment to find an answer?

Student Worksheet:

Before-Reading Discussion:

- What things do you consider when you are making a decision?
- In what circumstances might it be dangerous to make a decision too quickly?

After Reading:

- Have students answer questions at the bottom of the worksheet.

Answers to Worksheet Questions:

1. Answers will vary.
2. Answers will vary, but may include a discussion on whether or not teens, whose brains are still developing, should be given the same rights and be held to the same standards as adults.
3. Answers will vary, but may include brainstorming on how to pause and really consider the consequences of a decision. Teens may need to take time to research and gather facts about a situation or get advice from an adult before making a decision.
4. See steps at the end of the student article "TSI: Teen Science Investigations" for possible answers.

More Information

- For more information about the Intel ISEF Addiction Science Awards, visit www.drugabuse.gov/sciencefair.
- To find out more about the latest developments in addiction science, check out the blog at <http://teens.drugabuse.gov/blog>.
- To learn more about methamphetamine and tobacco addiction, visit <http://teens.drugabuse.gov>.

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 or www.scholastic.com/HEADSUP.

THE CASE OF THE TEEN BRAIN

Assignment: Study the article to learn more about the teen brain. Then complete the questions below.

● Investigator:

Dr. James Bjork, Scientist, National Institute on Drug Abuse, National Institutes of Health

● Mystery:

"I've always been interested in what it is about the brains of some people that causes them to do something that could irreversibly change their life," says Dr. Bjork. He started studying impulsive behavior in adults, but found that many highly destructive behaviors, such as drug abuse, start in adolescence. He wanted to find out if unique features exist in the teen brain that make this kind of impulsive behavior more likely.

● Uncovering Clues:

Dr. Bjork studied how people's brains respond to environmental challenges when they are making decisions.

Experiment Design: Dr. Bjork asked adults and adolescents to play a game that involved a conflict between being able to win a guaranteed reward or risking it all for the opportunity to win more.

Data Collection: As the participants played the game, Dr. Bjork studied their brain activity using *functional Magnetic Resonance Imaging* (fMRI). This specialized brain scan allowed him to see which areas of the brain were engaged (or activated) when the participants made decisions about what risks to take in the game.

Data Analysis: Dr. Bjork's research showed that while the game was being played, the *middle frontal cortex* was much more engaged/active in adults than in teens.

"I had to present adolescents with a very clear and severe threat of monetary loss [in the game] to start getting that area of the brain to become active," says Dr. Bjork. These findings are supported by other research that shows that the brain continues to mature through a person's 20s, and that the frontal cortex of the brain is one of the last sections to fully mature.

● Drawing Conclusions:

Dr. Bjork's findings may help us understand why adolescence is a

time of heightened risk-taking behavior. His experiment shows that a part of the cortex that helps us weigh risks and rewards is less active in teens, and this may affect how they make decisions. By being less sensitive to risk and more impulsive, teens could make unwise decisions about drugs, especially when the consequences of drug use are not always immediate or clear. Not all risk-taking, however, is bad for one's health. Teens' spirit for adventure means they can be more open to positive risks, such as taking up the challenge of learning a new skill, making new friends, or becoming interested in a new hobby.

Dr. Bjork suggests that this research supports the idea that restrictions, including legal ones, may be needed to help protect teens from some risky situations. These restrictions include the 21-year-old drinking age law and possibly even graduated driver's licenses that give teens increased driving privileges over time.

Photo credit: magnifying glass © i-Stockphoto.

QUESTIONS

(Write your answers on a separate sheet of paper.)

1. Dr. Bjork's research suggests that teenagers may be more likely to act impulsively than adults and make risky decisions. Can you think of instances where you have observed this to be true, and/or instances where you have observed this *not* to be true?
2. Dr. Bjork's research suggests that teens' brains are different from adults' brains when it comes to weighing risks and rewards in making a decision. Given these findings, do you think that teens should be held accountable for their actions? Why or why not? Under what circumstances?
3. How can teens use the findings from Dr. Bjork's study to help them make better decisions when they are in risky situations, including those involving drugs and alcohol?
4. Dr. Bjork's research follows the scientific method. Which steps of the scientific method can you identify in the description of his research above? See the magazine article "TSI: Teen Science Investigations" for clues.