ScienceNewsLearning

EDUCATOR GUIDE

February 10, 2024

Water Burbling Physics and THC and the Teenage Brain

SOCIETY FOR SCIENCE

ScienceNewsLearning

About this Guide

Have students investigate the physical science behind everyday phenomena, like the sound of running water, and critically analyze the potential risks of consuming THC-products using these lesson plans paired to two Science News articles from the February 10 issue.

This Guide includes:

Lesson Plan: Cannabis and the Teenage Brain

> **Learning Overview:** Being legal doesn't mean a drug is harmless. As the adult legal access to cannabis products goes up, teens' perception of cannabis risks falls. Learn how science reveals the harm THC may pose to teens while answering questions and discussing how the evidence from such studies supports conclusions.
>
> **NGSS-DCI:** HS-ETS1.
>
> **Paired Articles:**
> *Science News:* "The teen brain is especially susceptible to the harms of THC"
> Readability Score: 12.2
>
> *Science News Explores:* "The teen brain is especially vulnerable to the harms of cannabis"
> Readability Score: 7.3
>
> **Student Worksheet**: These questions are formatted so it's easy to choose the ones that will work for your students, post them to your LMS or print them off as a worksheet.

Lesson Plan: The physics behind burbling water

> **Learning Overview:** The sound of running water can evoke thirst or make for a relaxing environment. Physicists have recently figured out what causes the burbling of this alluring sound. Get your students thinking critically about this everyday phenomenon and explore possible variables behind it. Then have them read about a recent scientific study that explains the physical science principles behind the burbling water.
>
> **NGSS-DCI:** HS-PS4; MS-PS4; HS-ETS1; MS-ETS1.
>
> **Paired Article:**
> *Science News:* "Here's the science behind the burbling sound of water being poured"
> Readability Score: 9.0
>
> **Student Worksheet**: These questions are formatted so it's easy to choose the ones that will work for your students, post them to your LMS or print them off as a worksheet.

ScienceNewsLearning

Lesson Plan: Cannabis and the Teenage Brain

Learning Overview: Being legal doesn't mean a drug is harmless. As the adult legal access to cannabis products goes up, teens' perception of cannabis risks falls. Learn how science reveals the harm THC may pose to teens while answering questions and discussing how the evidence from such studies supports conclusions.

NGSS-DCI: HS-ETS1.

Paired Articles:
Science News: "The teen brain is especially susceptible to the harms of THC"
Readability Score: 12.2

Science News Explores: "The teen brain is especially vulnerable to the harms of cannabis"
Readability Score: 7.3

Directions: To engage students before reading the article, have them answer the "Before Reading" questions as a warmup in class. Then, break students into small groups. Instruct them to read the introduction of the online *Science News* article "The teen brain is especially susceptible to the harms of THC." Afterward, have them answer the "Introduction" questions.

Assign each group a different section of the article to read. Then ask them to answer the relevant "During Reading" questions. Once students are finished with their section's questions, have each group summarize their section for the rest of the class in 2-3 sentences. This should describe the main scientific claims in the section and supporting claims with data from the article.

After having student groups share their summaries, use the "After Reading" questions as a class discussion or as homework.

This article also appears in the February 10 issue of Science News. Science News Explores offers another version of the same article written at a middle-school reading level. Post this set of questions without answers for your students using this link.

Before Reading

1. Discuss the following question as a class. Frequent use of which of the following could pose a high risk of harm to you? Ask students to rank the following substances from most harmful to least: cigarettes, alcohol, cocaine, heroin and cannabis.

Answers will vary.

2. Human brains carry out a lot of growth and development during adolescence. With this in mind, how important is it to make healthy brain decisions during our teen years versus when we are adults? In other words, is it more, less, or equally important for us to make healthy decisions as teens and adults, based on what we know about brain development? Explain your answer.

Answers will vary.

During Reading

Introduction

1. What percent of 12- to 17-year-olds perceive "great risk of harm" from smoking marijuana once or twice a week?

Only 35 percent of this age group perceive a "great risk of harm" from this habit.

2. What idea does the widespread availability of cannabis for adults promote in young people, according to Beth Ebel?

Ebel says that the widespread availability of cannabis to adults promotes the idea that cannabis is safe.

3. What is the full name and abbreviation of the main psychoactive chemical in marijuana plants? How has the percentage by weight of this chemical in the marijuana plant changed in the past few decades?

Delta-9-tetrahydrocannabinol, or THC, is the psychoactive chemical in marijuana. The total share of THC by weight of the plant has increased from around 4 percent in 1995 to about 20 percent today. Plants are bred to contain more THC today.

"How does THC affect the teen brain?"

1. Why is adolescence a risky time to be using cannabis, according to Yasmin Hurd?

Adolescence is a risky time to use cannabis because the brain is still developing.

2. Describe three aspects of human function that are influenced by the endocannabinoid system.

Answers may include any of the following. This system plays a role in brain development. This system helps control anxiety, pain, memory and motivation. This system also affects how the brain's structure changes as an adolescent develops into adulthood.

3. Describe how THC can interfere with the body's endocannabinoid system. What are some impacts of this?

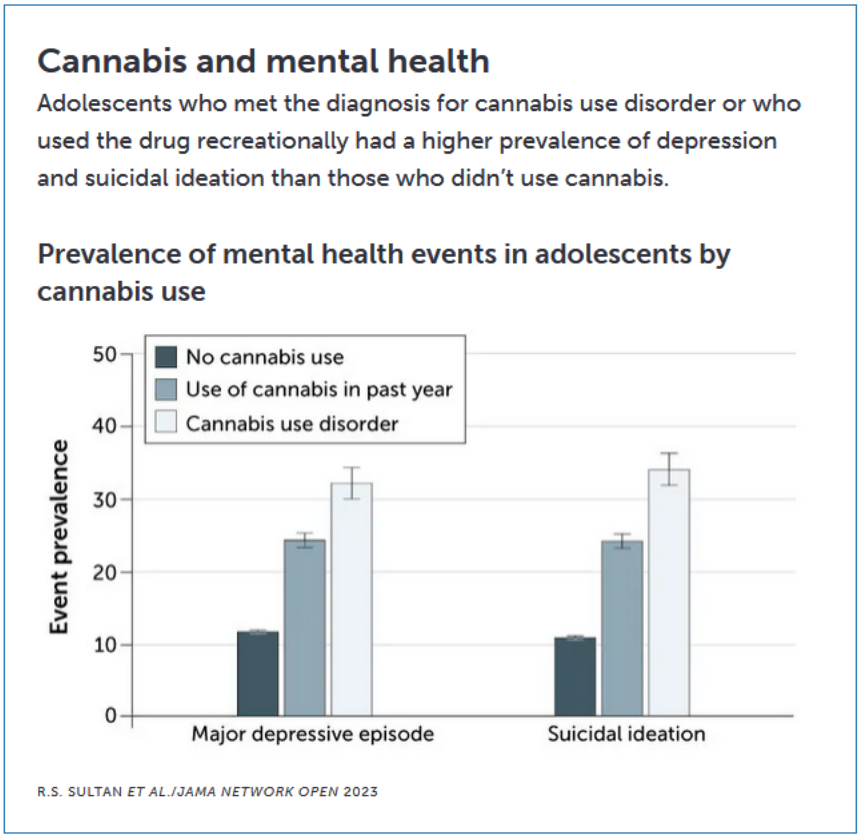
THC can reduce receptors in the brain not only tied to memory but also that lead to long-lasting problems with memory and learning. THC also can thin the prefrontal cortex, a region which helps with problem-solving and emotional regulation.

"Marijuana use is linked to mental health harms"

1. What is cannabis-use disorder?

This is a disorder in which people struggle to stop using cannabis despite it causing health problems or otherwise adversely affecting their daily lives.

2. Researchers studied rates of depression and suicidal thoughts among adolescents who consumed cannabis. Those who used the drug had a higher prevalence of depression and suicidal thought then did those who didn't. Now refer to the graph, "Cannabis and mental health." Provide data from it that supports the researcher's claim.



The study showed that people who used cannabis in the past year were more than twice as likely to develop these problems. Those with cannabis-use disorder were more than over three times as likely to develop the problems.

3. What does the article highlight as possible future consequences for teens who become dependent on marijuana at a young age?

Daily use of cannabis as a teen could lead to becoming dependent on cannabis as an adult, to using other drugs, to attempt suicide, and to lower the likelihood of finishing high school.

"The risks of using concentrated cannabis products"

1. According to a 2020 study, how did preferred methods of cannabis consumption by teens change from 2015 to 2018?

Compared to 2018, teen cannabis users who smoked cannabis dropped by 90 percent, while the share of teen users who vaped cannabis increased by 35 percent.

2. What is “high-potency cannabis?”

High-potency cannabis refers to products that contain a THC content of 10 percent or more.

3. What are some risks of using high-potency cannabis? Why do Ebel and Hurd argue that high-potency products are alarming?

Higher potency could lead to a higher risk of psychosis and cannabis hyperemesis syndrome. High-potency products are alarming because the effects haven’t been studied, so there remain many potential unknown risks.

After Reading

1. Why might today’s teens be at even greater risk from cannabis use compared to teens in the past? Refer to information from this article to support your answer. To what extent might this greater risk lead some adults to misunderstand risks of cannabis use by kids?

Answers will vary. Students point out that modern cannabis is bred to contain higher levels of THC than in the past. This could lead some adults to believe that cannabis might be no more harmful than when they were kids.

2. This article describes various studies supporting the conclusion that THC causes harm to developing brains. Pick one of these studies and explain how the evidence from this study supports the conclusion that THC can harm the teenage brain.

Answers will vary regarding the chosen study. But one option is the 2019 study by Hurd’s team. It found that injections of THC into the brains of adolescent rats resulted in changes to the prefrontal cortex and that connections between the nerve cells were disrupted when compared to nerve connections in rats that had not been injected with THC.

ScienceNewsLearning

Student Worksheet: Cannabis and the Teenage Brain

Directions: Read the online *Science News* article "The teen brain is especially susceptible to the harms of THC." Then answer the following questions as directed by your teacher. Because the article is long, the questions are broken up by the article's subheadings.

Before Reading

1. Discuss the following question as a class. Frequent use of which of the following could pose a high risk of harm to you? Ask students to rank the following substances from most harmful to least: cigarettes, alcohol, cocaine, heroin and cannabis.

2. Human brains carry out a lot of growth and development during adolescence. With this in mind, how important is it to make healthy brain decisions during our teen years versus when we are adults? In other words, is it more, less, or equally important for us to make healthy decisions as teens and adults, based on what we know about brain development? Explain your answer.

During Reading

Introduction

1. What percent of 12- to 17-year-olds perceive "great risk of harm" from smoking marijuana once or twice a week?

2. What idea does the widespread availability of cannabis for adults promote in young people, according to Beth Ebel?

3. What is the full name and abbreviation of the main psychoactive chemical in marijuana plants? How has the percentage by weight of this chemical in the marijuana plant changed in the past few decades?

"How does THC affect the teen brain?"

1. Why is adolescence a risky time to be using cannabis, according to Yasmin Hurd?

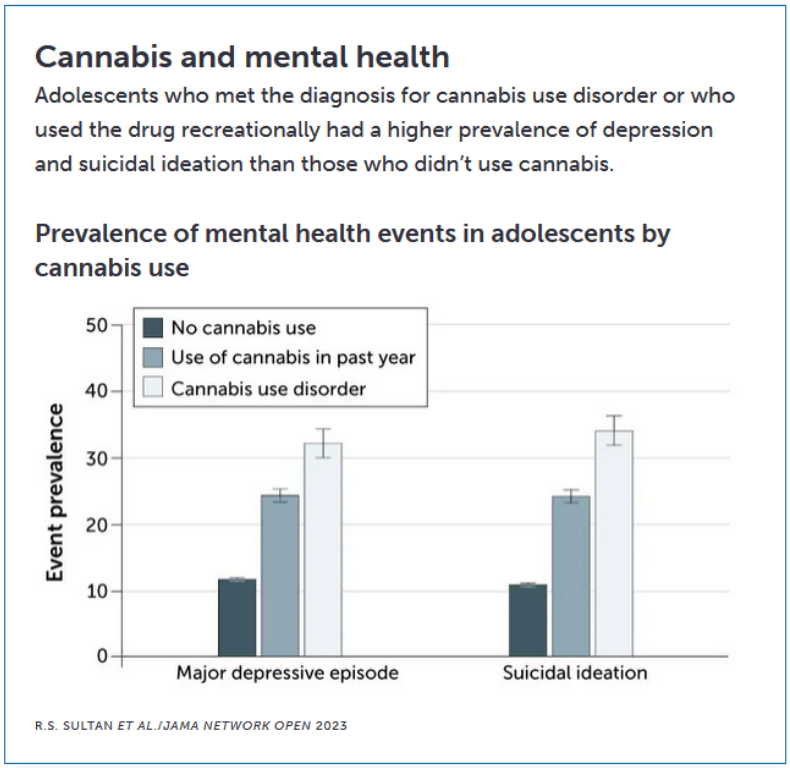
2. Describe three aspects of human function that are influenced by the endocannabinoid system.

3. Describe how THC can interfere with the body's endocannabinoid system. What are some impacts of this?

"Marijuana use is linked to mental health harms"

1. What is cannabis-use disorder?

2. Researchers studied rates of depression and suicidal thoughts among adolescents who consumed cannabis. Those who used the drug had a higher prevalence of depression and suicidal thought then did those who didn't. Now refer to the graph, "Cannabis and mental health." Provide data from it that supports the researcher's claim.



3. What does the article highlight as possible future consequences for teens who become dependent on marijuana at a young age?

“The risks of using concentrated cannabis products”

1. According to a 2020 study, how did preferred methods of cannabis consumption by teens change from 2015 to 2018?

2. What is “high-potency cannabis?”

3. What are some risks of using high-potency cannabis? Why do Ebel and Hurd argue that high-potency products are alarming?

After Reading

1. Why might today’s teens be at even greater risk from cannabis use compared to teens in the past? Refer to information from this article to support your answer. To what extent might this greater risk lead some adults to misunderstand risks of cannabis use by kids?

2. This article describes various studies supporting the conclusion that THC causes harm to developing brains. Pick one of these studies and explain how the evidence from this study supports the conclusion that THC can harm the teenage brain.

ScienceNewsLearning

Lesson Plan: The physics behind burbling water

Learning Overview: The sound of running water can evoke thirst or make for a relaxing environment. Physicists have recently figured out what causes the burbling of this alluring sound. Get your students thinking critically about this everyday phenomenon and explore possible variables behind it. Then have them read about a recent scientific study that explains the physical science principles behind the burbling water.

NGSS-DCI: HS-PS4; MS-PS4; HS-ETS1; MS-ETS1.

Paired Article:
Science News: "Here's the science behind the burbling sound of water being poured"
Readability Score: 9.0

Directions: The sound of running water is common to us all, and your class can easily investigate the physical scientific principles behind this phenomenon. Start off this lesson by calling students' attention to the phenomenon. If time is available, take students out for a nature walk to an active creek. Or you could bring a fountain to class or play a calming water sounds video as students enter the classroom. You could simply turn on your classroom faucet or pour water out of a pitcher into a glass. Have students take a few moments to individually answer the first set of questions ("Familiar sounds").

Then have your students investigate the phenomenon by experimenting on their own to identify variables that impact the water's sound and its volume. Set up your classroom so that each group can do their own water pouring experiment. Have students work through questions 1-5 in their group and then come together as a class to share results. Finally, either in class or for homework, have them read the *Science News* article "Here's the science behind the burbling sound of water being poured" and answer the last set of questions ("The science of burbling water").

Review sound waves with your students using the Introduction of this Science News Learning activity.

List of materials:

- Pitchers
- Plastic tubs
- Straws
- Squeeze bottles
- Water bottles
- Thermometer
- Hot and cold water
- Camera on phone or other device
- Pen or pencil to record observations.

Familiar sounds

1. What do you think of when you hear water burbling? How does it make you feel?

Student answers will vary.

2. Many commercial products, such as fountains and sound machines, incorporate the sounds produced from pouring or running water. What do think is the purpose of such products?

Students may say that the products drown out other noises, create a calming environment, promote relaxation, reduce stress, etc.

3. How could you create your own device to produce these water sounds? What would you have to investigate before you began developing a device?

Students should begin to think about what conditions and variables create and impact the sounds of water. For instance, I could use a pump to create a fountain. If the water flowed over a group of rocks, it might make soft bubbling sounds. But the sound might depend on the speed of the flow. If the water flowed too fast, it might not sound relaxing or could make a mess.

Making noise with water

With your group, using the materials provided, try to make the loudest sound you can by pouring water from one receptacle into another. Try manipulating as many variables as you can. Keep track of how loud you perceive the sounds to be or use an app for measuring sound volume. Once you've found the loudest sound you can make, take a video of your demonstration. Then, still pouring water from one receptacle to another, try to make the quietest sound you can. Once you've found the quietest sound, take a video of your demonstration.

1. What variables did you manipulate as a part of your water experiments? List them.

Temperature of water, height water was poured from, rate that water was poured from one receptacle to another, the type of vessel water was poured from and into, and how the vessels affected the size of the stream of water that was being poured.

2. How did you manipulate the variables to make the loudest sound? How about the quietest sound?

Student answers will vary but may say that water poured from a higher height made a louder sound and water poured from a lower height made a quieter sound.

3. Watch the videos of your demonstrations. How did the streams of water differ in the two videos? Explain the differences you observe.

Student answers will vary, but generally, thinner streams of water will create a louder sound than bigger streams of water.

The science of burbling water

1. Read the *Science News* article "Here's the science behind the burbling sound of water being poured." What did the scientists find makes the loudest sounds? Do the scientists' findings agree with yours?

Student answers will vary. In the article, scientists found that a column of falling water that develops ripples or breaks up into droplets produces the loudest sound. The higher the height that water was poured from

and the thinner the column of water, the more likely it was for ripples to form or the stream to break into droplets before impact. Those conditions produced the loudest sounds.

2. Explain where the sound you hear when pouring water comes from.

The sound comes from the air bubbles produced when the stream of water hits the surface of the water in the container. The air bubbles vibrate and cause air molecules to vibrate and collide with other molecules.

3. If you could perform the experiment again, are there any variables you would change to make a louder or quieter sound? Explain.

Student answers will vary. Students may note that they could decrease the height they are pouring from or use a vessel with a larger spout to try to make a quieter sound. On the other hand, they could increase the height or use a vessel with a smaller spout to try to make a louder sound.

ScienceNewsLearning

Student Worksheet: The physics behind burbling water

Directions: Answer the following questions as directed by your teacher.

Familiar sounds

1. What do you think of when you hear water burbling? How does it make you feel?

2. Many commercial products, such as fountains and sound machines, incorporate the sounds produced from pouring or running water. What do think is the purpose of such products?

3. How could you create your own device to produce these water sounds? What would you have to investigate before you began developing a device?

Making noise with water

With your group, using the materials provided, try to make the loudest sound you can by pouring water from one receptacle into another. Try manipulating as many variables as you can. Keep track of how loud you perceive the sounds to be or use an app for measuring sound volume. Once you've found the loudest sound you can make, take a video of your demonstration. Then, still pouring water from one receptacle to another, try to make the quietest sound you can. Once you've found the quietest sound, take a video of your demonstration.

1. What variables did you manipulate as a part of your water experiments? List them.

2. How did you manipulate the variables to make the loudest sound? How about the quietest sound?

3. Watch the videos of your demonstrations. How did the streams of water differ in the two videos? Explain the differences you observe.

The science of burbling water

1. Read the *Science News* article "Here's the science behind the burbling sound of water being poured." What did the scientists find makes the loudest sounds? Do the scientists' findings agree with yours?

2. Explain where the sound you hear when pouring water comes from.

3. If you could perform the experiment again, are there any variables you would change to make a louder or quieter sound? Explain.