ScienceNews
EDUCATOR GUIDE

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Voles Don’t Need Oxytocin to Bond

SOCIETY FOR SCIENCE

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About this Guide

Scientists thought the "love hormone" oxytocin was required to help animals form social bonds. In this Guide, students will learn how a study using a gene-editing tool called CRISPR is questioning that perspective — at least for prairie voles.

This Guide includes:

Article-based Comprehension Q&A — Students will answer questions about the online *Science News* article "Prairie voles can find partners just fine without the 'love hormone' oxytocin," which explores how scientists upended a common understanding of the hormone by using CRISPR technology. A version of the article "Voles don't need oxytocin to bond" appears in the February 25, 2023 issue of *Science News*. Related standards include NGSS-DCI: HS-LS1.

> **Student Comprehension Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

Cross-curricular Discussion Q&A — Students will learn how CRISPR gene-editing technology works and discuss its applications and its importance to research. Learning Outcomes: Learning about CRISPR and why it is an important technology. Related standards include NGSS-DCI: HS-LS1; MS-LS4.

> **Student Discussion Worksheet** — These questions are formatted so it's easy to print them out as a worksheet.

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Article-based Comprehension, Q&A

Directions for teachers: Ask students to read the online *Science News* "Prairie voles can find partners just fine without the 'love hormone' oxytocin" and have them answer the following questions. A version of the article "Voles don't need oxytocin to bond" appears in the February 25, 2023 issue of *Science News*.

1. What is oxytocin, and what role does it play in the lives of humans and other mammals?

Oxytocin is a hormone, and scientists have found that it influences social behavior in humans and other animals.

2. Which research findings described in this article made scientists think oxytocin was required for prairie voles to form pair-bonds and mate for life?

Scientists had shown in previous studies that prairie voles did not form pair-bonds when they were given drugs that blocked oxytocin's ability to act.

3. Which new technology did biologist Devanand Manoli and his colleagues use in their prairie vole study? How did the technology alter the prairie voles and allow the researchers to study their pair-bonding behavior?

The scientists used CRISPR technology to genetically modify the prairie voles. CRISPR technology can be used to turn off particular genes with the help of molecules from bacteria. Researchers used CRISPR to create prairie voles without functioning oxytocin receptors to allow them to study the behavior of prairie voles that don't experience oxytocin signaling in the brain.

4. How did the modified prairie voles behave?

The animals formed pair-bonds without needing oxytocin.

5. How did the new study differ from past studies on oxytocin and prairie vole behavior? How did using a new technology produce surprising results?

In past studies, drugs were used to block oxytocin in adult prairie voles whose brains had previous exposure to oxytocin. Using CRISPR made it possible to make prairie voles whose brains had never been exposed to oxytocin. Because the prairie voles in earlier studies appeared to depend on oxytocin to form pair-bonds, the scientists expected the prairie voles without functioning receptors to fail at forming bonds. Using CRISPR made it possible to show a surprising result: Prairie voles do not depend on oxytocin to form pair-bonds.

6. What are possible next steps in the research on pair-bonding in voles?

Scientists want to continue studying oxytocin's role in pair-bonding. Researchers also are looking at the roles played by other hormones, including vasopressin.

Optional extension: Using the main scientific finding from the article, outline the scientists' claim, evidence and reasoning to support their finding.

Claim: Oxytocin is not necessary for voles to form pair-bonds.
Evidence: After using CRISPR to remove the receptor for oxytocin, voles still formed pair-bonds.
Reasoning: The fact that prairie voles formed pair-bonds without the influence of oxytocin suggests that something else in prairie voles' biology is influencing that behavior, and the biological factors that influence whether animals form pair-bonds is more complicated than previously thought.

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Student Comprehension Worksheet

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1. What is oxytocin, and what role does it play in the lives of humans and other mammals?

2. Which research findings described in this article made scientists think oxytocin was required for prairie voles to form pair-bonds and mate for life?

3. Which new technology did biologist Devanand Manoli and his colleagues use in their prairie vole study? How did the technology alter the prairie voles and allow the researchers to study their pair-bonding behavior?

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5. How did the new study differ from past studies on oxytocin and prairie vole behavior? How did using a new technology produce surprising results?

6. What are possible next steps in the research on pair-bonding in voles?

Optional extension: Using the main scientific finding from the article, outline the scientists' claim, evidence and reasoning to support their finding.

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Cross-curricular Discussion, Q&A

Directions for teachers:
Ask students to read the *Science News* article "Prairie voles can find partners just fine without the 'love hormone' oxytocin" or any other *Science News* article that includes research that used CRISPR gene-editing technology. A version of the article "Voles don't need oxytocin to bond" appears in the February 25, 2023 issue of *Science News*. Then students should pair up and discuss the first set of questions with their partners.

Before answering the second set of questions, have students read "Explainer: How CRISPR works" from *Science News Explores.* Additional information about the technology can be found in "How CRISPR lets you edit DNA," a TED-Ed lesson, and "What Is CRISPR, and Why Is It So Important?" from *Scientific American*.

Check out our Great gene-editing debate activity lesson plan for a debate on the creation of gene-edited babies. The debate can be adapted for any topic.

What you already know about CRISPR/Cas9
1. Do you know about CRISPR? What have you learned or heard about CRISPR/Cas9 and its applications?

Student answers will vary. I have learned that CRISPR/Cas9 is a powerful gene editing tool and that it is used in scientific research.

2. The *Science News* article describes how CRISPR/Cas9 was an integral part of a recent scientific study. What were the researchers studying? What organism did the scientists modify, and what was the modification?

The researchers were studying oxytocin's role in pair-bonding in prairie voles. The researchers used CRISPR/Cas9 to genetically engineer prairie voles without functioning oxytocin receptors.

3. What was the outcome of the research study? Explain how using CRISPR/Cas9 technology influenced the scientific findings.

The outcome of the study was that even without functioning oxytocin receptors, the prairie voles formed pair-bonds. This research conflicted with the findings of an earlier study that suggested oxytocin was necessary for pair-bonding. Using CRISPR made it possible to create a situation where, from birth, oxytocin could not influence prairie vole pair-bonding and thereby show that pair-bonding might be influenced by substances other than oxytocin or by certain behaviors.

Describing the "miracle" of CRISPR

1. What does CRISPR mean? Which organism does it come from? Describe how it works in that organism.

CRISPR stands for "clustered regularly interspaced short palindromic repeats." These repeats are small pieces of viruses found in the DNA of some bacteria. The bacteria incorporate these small pieces of DNA from viruses when the viruses invade the bacteria. In subsequent viral invasions, the bacteria use CRISPR to recognize the viruses and mount a defense against the invaders.

2. What is Cas9? How does it relate to CRISPR?

Cas9 is an enzyme that cuts DNA strands of threatening viruses. CRISPR and Cas9 work together in bacteria to fight against viral invasions. CRISPR helps the bacteria recognize the virus, and Cas9 disables it.

3. Use the article to write your own description of how CRISPR/Cas9 technology works. Together you and your partner should write a brief summary.

Scientists design guide RNA and attach it to the Cas9 enzyme so it can locate a particular sequence of base pairs in an organism's DNA. Once the RNA attaches to the intended region of DNA, the Cas9 protein cuts both strands of DNA at that point. If left to its own devices, a cell will fix the break in a sloppy way that will likely turn off the gene. Scientists can now replace the snipped DNA section with a new sequence of DNA, a single nucleotide base or even a fluorescent protein to tag a section of the DNA.

4. The *Science News Explores* article refers to CRISPR as "collections of viral mug shots" that can help viruses find and destroy viruses, and Cas9 as a "multifunctional tool." Other resources have used the "find and replace" computer function to describe CRISPR/Cas9 technology. Working with your partner, find other literary devices such as metaphors and similes that have been used when describing CRISPR/Cas9 technology.

Student answers will vary. Terms like "molecular scissors," "computer mouse" and "knife" have appeared in explanations of CRISPR/Cas9 technology.

5. What are other applications of CRISPR mentioned in the article? Can you think of a plant or animal that could be genetically modified to help solve a problem or alleviate an issue? What organism should be modified and what would the intended outcome of the genetic modification be?

Students might talk about using genetic engineering to modify immune cells to treat diseases like leukemia and lung cancer, or modify lab animals that could mimic the symptoms of other human diseases. Students could mention using genetic engineering to make certain crops resistant to droughts, floods, pests or extreme temperatures. Genetic engineering could also be used to increase crop yields.

6. Why do scientists consider CRISPR/Cas9 a scientific "miracle?" Discuss whether you agree with this assessment. What other questions do you have about how the technology works?

CRISPR/Cas9 is a reliable, efficient, inexpensive way to manipulate genes. Other questions: How does CRISPR find only the intended modification site? Are there any unintended consequences of using CRISPR/Cas9 technology? In what kinds of experiments has CRISPR/Cas9 technology failed? Other student opinions will be different.

7. Is it ethical to genetically modify an organism? Discuss why or why not, while being respectful of your classmates' opinions.

Student answers will vary. I think every case involving the genetic modification of an organism must be studied carefully. If a genetic modification will save human and animal lives or prevent the spread of diseases, that seems ethical, if the modifications don't cause other harms. For instance, genetically modifying a food crop to protect it from disease might not be a good idea if the changes could affect other nearby plants in negative ways. Also, I am not so sure about genetic modifications just to make something look different.

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Student Discussion Worksheet

Directions: Read the *Science News* article "Prairie voles can find partners just fine without the 'love hormone' oxytocin" or another article assigned by your teacher before discussing the first set of questions with a classmate. A version of the article "Voles don't need oxytocin to bond" appears in the February 25, 2023 issue of *Science News*. Then read the *Science News Explores* article "Explainer: How CRISPR works" and answer the questions in the second section.

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3. What was the outcome of the research study? Explain how using CRISPR/Cas9 technology influenced the scientific findings.

Describing the "miracle" of CRISPR

1. What does CRISPR mean? Which organism does it come from? Describe how it works in that organism.

2. What is Cas9? How does it relate to CRISPR?

3. Use the article to write your own description of how CRISPR/Cas9 technology works. Together you and your partner should write a brief summary.

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