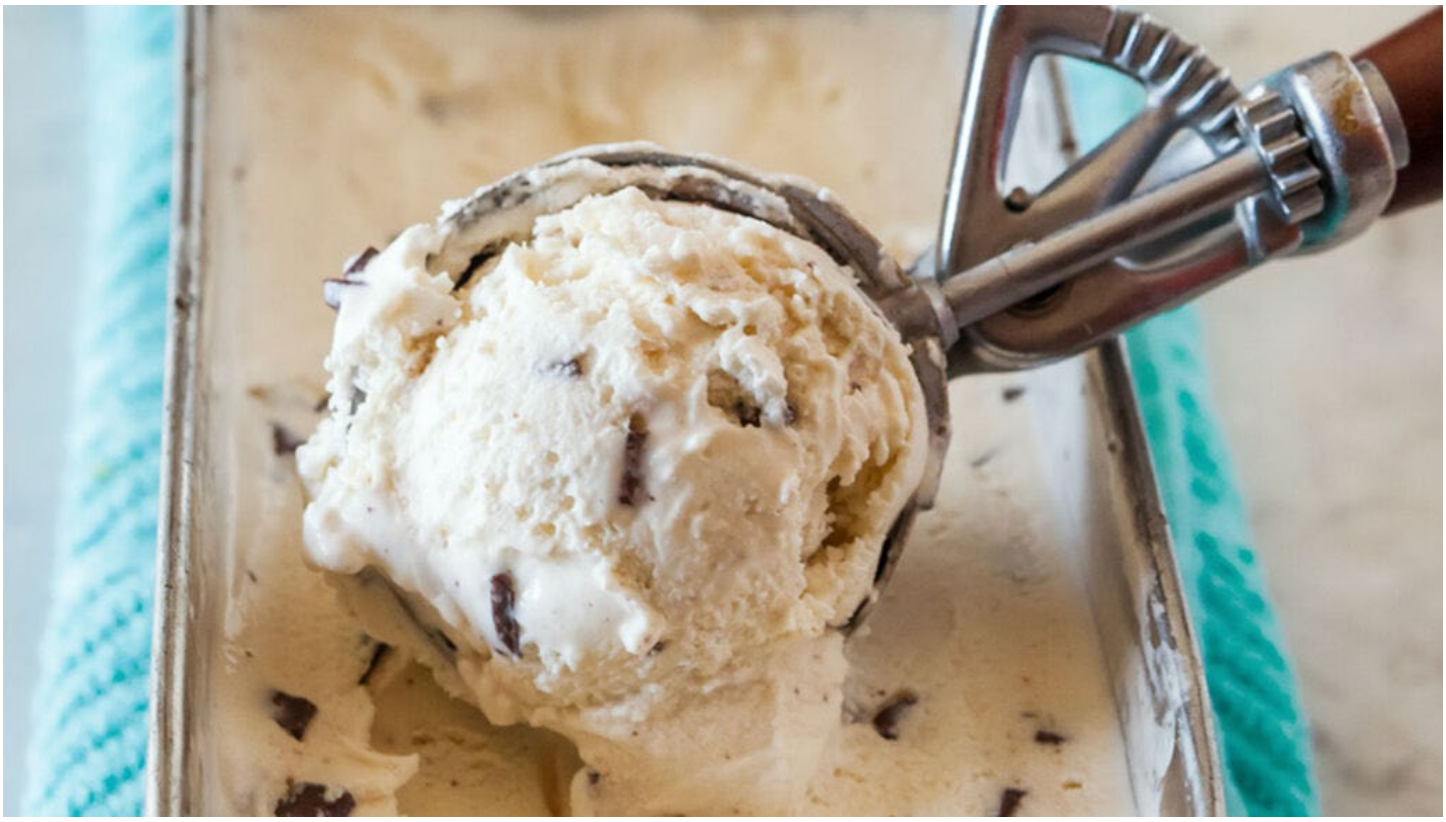
# ScienceNews
## EDUCATOR GUIDE



AMERICAN HERITAGE CHOCOLATE/UNSPLASH

**May 7, 2022 & May 21, 2022**

# Cellulose Helps Ice Cream Go Down Smooth

SOCIETY FOR SCIENCE

SN EDUCATOR GUIDE

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## About this Guide

In this Guide, based on the online *Science News* article "Grainy ice cream is unpleasant. Plant-based nanocrystals might help," students will learn about how food scientists are using chemistry to improve the texture of ice cream, discuss the science of ice cream on a molecular level and brainstorm testable scientific questions about favorite frozen desserts.

**This Guide includes:**

**Article-based Comprehension Q&A —** Students will answer questions about the online *Science News* article "Grainy ice cream is unpleasant. Plant-based nanocrystals might help," which describes new research into improving the shelf life of ice cream. A version of the article, "Cellulose helps ice cream go down smooth," appears in the May 7, 2022 & May 21, 2022 issue of *Science News*. Related standards include NGSS-DCI: HS-PS3; HS-ETS1.

> **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 analyze and write a caption for microscope images of crystals in an ice cream–like solution, discuss how molecules behave as ice cream freezes and thaws, and pose scientific questions about a favorite frozen dessert. Related standards include NGSS-DCI: HS-PS1; HS-PS3; HS-ETS1.

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## Article-based Comprehension, Q&A

**Directions for teachers**: Ask students to read the online *Science News* article "Grainy ice cream is unpleasant. Plant-based nanocrystals might help," and answer the following questions. A version of the article, "Cellulose helps ice cream go down smooth," appears in the May 7, 2022 & May 21, 2022 issue of *Science News*.

**1. Why does ice cream sometimes develop a grainy texture?**

Ice cream becomes grainy when ice crystals in the mixture grow to a diameter of 50 micrometers or more. The crystals grow as they melt and reform over time due to natural temperature fluctuations.

**2. How do ice cream manufacturers currently keep ice cream from getting grainy? How well does this solution work?**

Food stabilizers such as guar gum are added to ice cream. These gum stabilizers slow the ice crystals' growth, but do not stop it. Ice cream with gum stabilizers will eventually become grainy, but not as quickly as ice cream without stabilizers.

**3. What new potential solution are scientists investigating?**

Scientists are investigating cellulose nanocrystals, or CNCs, as an additive. CNCs are derived from wood pulp and have properties similar to guar gum.

**4. In your own words, describe food scientist Tao Wu and colleagues' experimental setup. What did they use as a substitute for ice cream in their study, and what were the components of each test solution?**

The team used a sucrose solution as a substitute for ice cream. They compared crystal growth in sucrose solution with CNCs added and sucrose solution with guar gum added.

**5. What did the experiments reveal?**

In the sucrose solution with CNCs added, ice crystals stopped growing after 24 hours and after one week, remained at a diameter of 25 micrometers. In sucrose solution with guar gum, ice crystals grew to 50 micrometers in three days.

**6. What does food engineer Richard Hartel say about the findings? Why do you think the author of the *Science News* article included Hartel's perspective in the story?**

Hartel says the findings suggest that the CNCs are more effective than gum stabilizers. The author may have included Hartel's perspective because he is an expert in the field who was not involved in the research, so his analysis of the work is likely to be unbiased.

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## Cross-curricular Discussion, Q&A

**Directions for teachers:**
Ask students to read the online *Science News* article "Grainy ice cream is unpleasant. Plant-based nanocrystals might help" and answer the questions according to the instructions. A version of the article, "Cellulose helps ice cream go down smooth," appears in the May 7, 2022 & May 21, 2022 issue of *Science News*.

**Want to make it a virtual lesson?** Post the online *Science News* article to your virtual classroom. Discuss the article and questions with your class on your virtual platform.

**Picture this**
1. Find the pictures within the text of the article. Without reading the picture caption, spend about 30 seconds observing the pictures silently. Spend the next minute with a partner stating as many observations as you can about the pictures. Go back and forth naming observations.

*Student answers will vary. Observations might include: the backgrounds are teal, the droplets in the left-hand image look bigger than the droplets in the right-hand image, some droplets look to be connected on a few sides, about an inch in the images represents 100 micrometers, most droplets in the right-hand image appear to be about 10 to 20 micrometers wide, all droplets appear to be clear, etc.*

2. Based on what you observed in the pictures and the headline of the online *Science News* article "Grainy ice cream is unpleasant. Plant-based nanocrystals might help," what do you think the pictures show?

*The pictures appear side by side, probably so that the reader can compare them. Based on the article headline, the left-hand image might be grainy regular ice cream and the right-hand image could be ice cream that contains plant-based nanocrystals.*

3. Read the text of the article, again making sure to avoid reading the caption. Using details that you learned from the article, explain what you see in the pictures.

*The pictures show ice crystals in sucrose solutions. The solution shown in the right-hand image likely contains cellulose nanocrystals because the ice crystals are smaller than the crystals shown in the left-hand image and scientists found that cellulose nanocrystals stunted ice crystal growth.*

4. Write your own caption for the pictures.

*Cellulose nanocrystals that scientists added to sucrose solution (right) stopped ice crystals from growing as large as the ice crystals in sucrose solution without CNCs (left).*

5. Do you think the pictures are an effective addition to the article? Why or why not?

*Yes, the pictures are a nice addition to the article. They help readers visualize the researchers' findings.*

**The molecular lens**

1. If you could see water ice crystals in the solution at a molecular level, describe what you might see. How would the molecules be arranged, how would they be moving, etc.?

*I would see water molecules ($H_2O$) forming many repeating hexagonal lattices. The oxygen in one molecule would be attracted to the hydrogen in another molecule. The molecules would be locked into a fixed, solid structure and would moving slightly.*

2. Describe what you would probably see in the sucrose solution without cellulose nanocrystals as it experiences cycles of warming and cooling.

*As the solution gets warmer, the water molecules would begin to move faster. Molecules near the outside of the lattice would begin to break away and could move more freely around the solution. The volume of solid ice overall in the solution would decrease. When the molecules in the solution cooled again, all molecular motion would slow. Water molecules would attract one another and begin to form solid lattice structures. Refreezing would cause the ice crystals to grow to a larger size than they were originally.*

3. Describe what you would probably see as the sucrose solution with cellulose nanocrystals experienced cycles of heating and cooling.

*A similar melting and refreezing process would occur. The cellulose nanocrystals would somehow interfere with the reformation of ice. Ice crystals wouldn't be as big as they were if the nanoparticles weren't in solution.*

4. Cellulose nanocrystals are considered food additives. Define the term "food additive" based on your understanding of the article.

*Food additives are substances that are added to food to preserve it or enhance its texture, taste, appearance or some other aspect.*

**Frozen favorites**

1. According to the first sentence of the *Science News* article, "You can never have too much ice cream, but you can have too much ice in your ice cream." What have you learned about the composition and texture of ice cream from this article?

*Student answers will vary, but they might say that the texture of ice cream depends on the size of ice crystals within it.*

2. What's your favorite type of frozen dessert (ice cream, gelato, sherbet, sorbet, frozen yogurt, nondairy frozen dessert, etc.)? Why?

*Student answers will vary.*

3. Look up information about your favorite dessert's ingredients and their ratios. Write a one-sentence description of your dessert using this additional information.

*Student answers will vary. One possible answer is that sorbets are made of mostly water, fruit and sugar or other sweeteners. Sorbets have an acidic pH and do not contain dairy.*

4. Imagine you are making your favorite frozen dessert. How could you improve the flavor or texture of the dessert by altering the ingredients or their ratios? Propose a testable scientific question for this modification.

*Will sorbet with a higher ratio of fruit compote taste better?*

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**Picture this**

1. Find the pictures within the text of the article. Without reading the picture caption, spend about 30 seconds observing the picture silently. Spend the next minute with a partner stating as many observations as you can about the pictures. Go back and forth naming observations.

2. Based on what you observed in the pictures and the headline of the online *Science News* article "Grainy ice cream is unpleasant. Plant-based nanocrystals might help," what do you think the pictures show?

3. Read the text of the article, again making sure to avoid reading the picture caption. Using details that you learned from the article, explain what you see in the pictures.

4. Write your own caption for the pictures.

5. Do you think the pictures are an effective addition to the article? Why or why not?

**The molecular lens**

1. If you could see water ice crystals in the solution at a molecular level, describe what you might see. How would the molecules be arranged, how would they be moving, etc.?

2. Describe what you would probably see in the sucrose solution without cellulose nanocrystals as it experiences cycles of warming and cooling.

3. Describe what you would probably see as the sucrose solution with cellulose nanocrystals experienced cycles of heating and cooling.

4. Cellulose nanocrystals are considered food additives. Define the term “food additive” based on your understanding of the article.

**Frozen favorites**

1. According to the first sentence of the *Science News* article, “You can never have too much ice cream, but you can have too much ice in your ice cream.” What have you learned about the composition and texture of ice cream from this article?

2. What’s your favorite type of frozen dessert (ice cream, gelato, sherbet, sorbet, frozen yogurt, nondairy frozen dessert, etc.)? Why?

3. Look up information about your favorite dessert’s ingredients and their ratios. Does the dessert contain any food additives? Write a one-sentence description of your dessert using this additional information.

4. Imagine you are making your favorite frozen dessert. How could you improve the flavor or texture of the dessert by altering the ingredients or their ratios? Propose a testable scientific question for this modification.