SICK! science®

insanely cool experiences

SUPER SODA GEYSER

EXPERIMENT GUIDE

as seen on YouTube™

POWERED BY Steve Spangler SCIENCE

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Concept based on a video series by Steve Spangler Science and distributed through the YouTube Original Content Series.

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SUPER SODA GEYSER

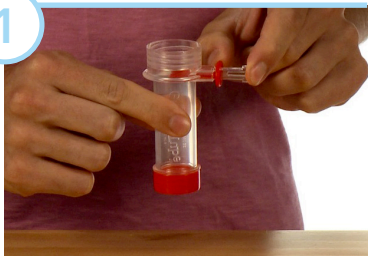
Who would have guessed that dropping Mentos® chewy mints into a bottle of soda would produce such a blast? The reaction - a giant eruption of soda - is as mysterious as it is sensation. Unravel the mystery behind this explosive experiment over and over again!

WHAT YOU NEED

- GEYSER TUBE
- 2 SODA BOTTLES
- TABLE SALT
- ROCK SALT
- DEPTH CHARGE
- MENTOS ROLL
- ADULT SUPERVISION

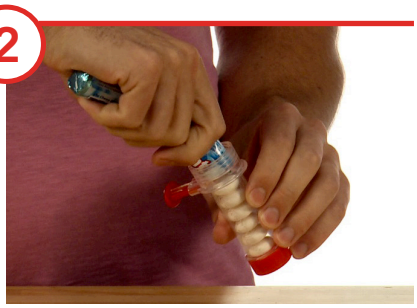
DEMONSTRATION #1

1



Open the Geyser Tube by pulling out the pin on the side.

2



Insert six Mentos into the tube.

3

Close the Geyser Tube by pushing-in the pin and flip over.

4

Open one of the soda bottles.

5

Carefully screw the Geyser Tube onto the soda bottle.

6

Release the Mentos into the soda bottle by pulling out the pin and stand back.

DEMONSTRATION #2

1

Unscrew the cap to the Geyser Tube, make sure the pin is at the "in" position.

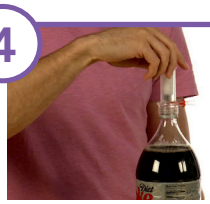
2

Assemble the Depth Charge and fill with rock salt or table salt.

3

Insert the Depth Charge into the Geyser Tube and tighten the cap.

4



Screw the Geyser Tube onto another soda bottle.

5

Release the Depth Charge into the soda bottle by pulling the pin. TIP: Use diet soda to avoid a sticky mess after all the geyser fun!

HOW DOES IT WORK

Here's the question of the day... Why do Mentos and soda produce this incredible eruption? While we offer the most probable explanations below, there is considerable debate over how and why this works. We also understand and admit that other explanations could be possible.

The thing that makes soda bubbly is carbon dioxide gas. Until you open the bottle, the gas mostly stays suspended in the liquid and cannot expand to form more bubbles, which gases naturally do. Water molecules strongly attract each other, linking together to form a tight mesh around each bubble of carbon dioxide gas in the soda. In order to form a new bubble, or even to expand a bubble that has already formed, water molecules must push away from each other. It takes extra energy to break this bond.

When Mentos are dropped into soda, the gelatin and gum arabic from the dissolving candy break the bonds of the water molecules. Each Mentos candy has thousands of tiny pits all over its surface called nucleation sites - perfect places for carbon dioxide bubbles to form because water cannot fit into these microscopic pits. As soon as the Mentos hit the soda, bubbles form all over the nucleation sites and grow into big enough bubbles to break through the bonds of the water molecules and rise to the surface. The Mentos sink to the bottom where the gas bubbles are released, and it pushes all the liquid up and out of the bottle in an incredible soda blast!

The Depth Charge was specially designed to allow you to test how well other materials work when it comes to creating a soda geyser. It's tough to test how well table salt or rock salt works if there's not a good (and consistent) way to drop it into the soda. With the Depth Charge, it is possible to really conduct tests under scientific conditions.

You probably noticed the small weight on the end of the Depth Charge. This causes it to drop quickly to the bottom of the soda bottle. When the Depth Charge hits the bottom, the two sides split apart and release the material (whatever you picked for your geyser starter) into the soda. It's important to get the starter material to the bottom of the bottle as quickly as possible to get the greatest geyser effect. Also, remember that the secret is to select a geyser starter that has a rough surface - with nucleation sites for carbon dioxide bubbles to collect and finally escape. Filling the Depth Charge with smooth marbles will produce no geyser, while tiny particles of sand or rock salt produces great geysers.

TAKE IT FURTHER

Now that you have created the ultimate Super Soda Geyser, try creating geysers out of other liquids. Think of other liquids that are carbonated and try them out! How are the geysers that these other liquids create different than the soda geysers? What might be making them different? Do they react differently to Mentos than to salt? Stand back and watch the possibilities explode!

SCIENCE FAIR CONNECTION

Observing and creating the Super Soda Geyser is pretty cool, but this activity isn't a science fair project, yet. You can make it one simply by identifying a variable (something that might change the outcome) in the experiment, then testing that variable, and correctly reporting the results. Think about some variables like these that you might test:

- Try altering the type of soda you use. Make sure you keep all other variables the same, including the temperature of the soda!
- Try using a different material in the Depth Charge instead of the rock salt.
- Try using different amounts of Mentos to see which creates the highest geyser.

These are just a couple of ideas, but you aren't limited to them! Come up with different ideas of variables to test and give them a try. Remember, you can only change one variable at a time for each test. For example, if you are testing different soda temperatures, make sure that all other factors in the test remain the same!

THIS EXPERIMENT

SCAN TO WATCH

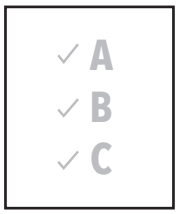
For step by step experiment instructions, the science behind it and ways to take it further, scan the code to the left.

Trouble scanning? Follow the URL below.
http://spanglersci.com/120wsks107tzofz8t7

WHAT ARE THESE SYMBOLS ALL ABOUT?

LAB REPORT

In this section, you will learn to define and prepare your experiments like scientists do. You will ask big questions, develop hypotheses, list materials, write procedures, record results and make big discoveries.

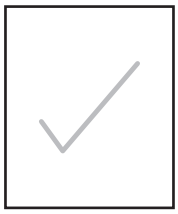


EXPERT VOCABULARY

In this section, you will learn to use the language scientists use to discuss and explain the concepts covered in this experiment.

CRITICAL THINKING

Follow the layers of critical thinking density with this icon. As the beakers fill from page to page, you will notice the level at which the beaker is filled indicates the depth of critical thinking needed to complete the question(s), from least complex being the least full to most complex being the most full.



ASSESSMENT

In this section, you will find questions at a variety of levels which assess student understanding of the scientific content covered in the experiment.

A WORD ABOUT SAFETY

Everything we suggest using in this guide is safe when used with proper adult supervision. We guarantee young scientists will get a lot more from the experience if you're there to guide them. Remember, this is science, and science tends to get a bit messy. Stuff falls on the floor... so you'll need to clean it up. Don't put chemicals in your eyes or ears and don't eat your experiment. Trust us, they don't taste good and it's a bad thing to do. The bottom line is that this science experiment guide requires adult supervision and common sense. These simple concepts help ensure a fun and safe experience.

TEACHER NOTES:

SCIENCE CONCEPTS OVERVIEW ▸ Nucleation, Physical Reaction

The learning experiences contained in the following Experiment Guide are designed to engage students and deepen understanding, not only of the underlying scientific concepts upon which these experiments/demonstrations are built, but also of critical thinking and problem solving skills. Teachers should allow students to actively participate in each activity as an investigation, where questions are being asked, hypotheses are developed and redeveloped, and where students own the discoveries. Vocabulary was included, assessments were created and critical thinking questions were designed with this underlying goal in mind.

Suggested Teaching Points:

Sick Science Teaching Points: The Sick Science video can be utilized in a variety of ways. It can be used to introduce a scientific concept or in place of doing the demonstration/experiment if materials are unavailable. The video can also be used as a review or to help students complete the various learning experiences included in this guide.

Vocabulary: Students enhance their science-content related vocabulary. You may choose to introduce the vocabulary words and explicitly teach the meaning of each. You may also use the vocabulary words as an investigation, where students may research the meanings of the words. Finally, students may develop their own meaning for each word through their experience with the experiments and critical thinking work.

The Scientific Method: Students can complete a full lab report for the demonstration, including asking questions, identifying variables, forming a hypothesis, designing the experiment, collecting data, and drawing conclusions. Differentiation using the lab report is easy. For lower levels, complete the lab report as a class. As students are more independent, encourage students to work in partnerships or groups to complete the lab report. Eventually, students should be able to complete the lab report independently or design a new experiment using the form based on the demonstration completed in class.

Identify Details: Students will identify the relevant details of a geyser starter that make the geyser reaction occur.

Cause and Effect: Students will identify cause and effect relationships and describe the connection between the carbonation level of the soda and the height of the geyser.

Generalize: Students will relate knowledge gained from the experiment/demonstration to other concepts, such as foam in root beer floats.

Literature Connection: Geysers (True Books: Earth Science) by Larry Dane Brimner. This read aloud is a great opportunity for students to learn about natural geysers and then to compare and contrast the way that natural geysers work to the way that our Super Soda Geyser works. Students may note how gases are retained and eventually released, what causes the build-up of gases, etc.

Writing Connection: Students can create a story from the perspective of a tiny carbon dioxide bubble that has been trapped in a soda bottle and finally gets released through the Super Soda Geyser. They should include the correct sequence of events that relate to the science behind this demonstration and use transition words to portray the order of events. They may also add creative and descriptive details to make the story their own.

Lab Report

NAME

BIG QUESTION:
Scientists ask big questions to guide their experiment.

What big question are we answering in this experiment?

HYPOTHESIS:
Scientists make predictions about what they think will happen during the experiment.

What is your hypothesis for this experiment?

Lab Report

NAME

MATERIALS AND PROCEDURES:
Scientists make a list of materials they need and will use in their experiments. It is important other scientists are able to duplicate and test each other's experiments.

What materials do you need to conduct this experiment?

Write out a step-by-step procedure for this experiment.

Lab Report

NAME

RESULTS AND OBSERVATIONS:
Scientists make observations and take notes as they conduct their experiments. Scientists are good observers and record all results of their experiments. It is important to measure your results using precise units and careful review.

What were the results of your experiment?

What did you observe as you conducted your experiment?

Lab Report

NAME

CONCLUSIONS AND DISCOVERY:
Scientists look carefully at their results, think critically about their observations, and draw conclusions about their experiments, as they relate to their big question and original hypothesis.

What conclusions and discoveries did you make after completing the experiment?

NEXT STEPS:
Sometimes after scientists conduct their experiments, they think of new questions they want to test in new experiments.

What new questions do you have after you have completed your experiment?

Expert Vocabulary

NAME _____

WORDS AND DEFINITIONS —
Match the word on the left with the correct definition on the right by filling in the blank with the correct letter.

VOCABULARY WORDS	DEFINITIONS
1 ____ **Nucleation Site**	A A process that leads to a change in the form of matter.
2 ____ **Physical Reaction**	B A group of two or more atoms that stick together.
3 ____ **Carbon Dioxide**	C The process of injecting a liquid with carbon dioxide gas and keeping it pressurized.
4 ____ **Molecules**	D A tiny area on a rough surface that molecules can attach to and begin a physical reaction from.
5 ____ **Carbonation**	E CO_2

Critical Thinking

NAME

IDENTIFY DETAILS —
Students will identify the relevant details of a geyser starter that make the geyser reaction occur.

What characteristics do a Mentos mint, table salt, and rock salt all have in common that help to create the geyser reaction when dropped into a soda?

Critical Thinking

NAME

CAUSE AND EFFECT —
Students will identify cause and effect relationships and describe the connection between the carbonation level of the soda and the height of the geyser.

You found an old bottle of soda in the back of the pantry, and you wonder if it would work for this experiment. You know that because it is now flat and has lost most of its carbonation because when you opened it up, hardly any carbon dioxide bubbles floated to the surface. What effect will using this flat soda have on your geyser when you drop the Mentos in?
Explain your thinking.

Critical Thinking

NAME

GENERALIZE —
Students will relate knowledge gained from the experiment/demonstration to other concepts, such as foam in root beer floats.

When making a root beer float, Emir noticed that as soon as he added the ice cream to his glass of root beer large bubbles or foam started to appear at the top of his glass. Using what you have learned from this demonstration, what is one possible explanation that you could give Emir about why he has so much foam in his root beer float? Use specific details and examples in your answer.

Assessment

NAME

ASSESSMENT QUESTIONS —
Read each question carefully and circle the letter next to the correct answer or write your response in the box.

1. Which gas is released from the soda causing the geyser effect?
   a. Helium
   b. Carbon monoxide
   c. Carbon dioxide
   d. Oxygen

2. An effective geyser starter must have a...
   a. small surface area.
   b. rough surface area.
   c. dissolvable shell.
   d. high density.

3. The place where carbon dioxide bubbles begin to build up is called the...
   a. nucleation site.
   b. central molecule.
   c. central nucleus.
   d. geyser site.

4. The geyser would probably shoot highest with...
   a. highly carbonated soda.
   b. non-carbonated (flat) soda.
   c. a lower amount of soda.
   d. a dark-colored soda.

5. Explain why something with a smooth surface, like a marble, would NOT create a geyser effect when dropped into carbonated soda.

_____

_____

_____

_____

Expert Vocabulary - Answer Key

WORDS AND DEFINITIONS —
Match the word on the left with the correct definition on the right by filling in the blank with the correct letter.

	VOCABULARY WORDS		DEFINITIONS
1	D	Nucleation Site	A. A process that leads to a change in the form of matter.
2	A	Physical Reaction	B. A group of two or more atoms that stick together.
3	E	Carbon Dioxide	C. The process of injecting a liquid with carbon dioxide gas and keeping it pressurized.
4	B	Molecules	D. A tiny area on a rough surface that molecules can attach to and begin a physical reaction from.
5	C	Carbonation	E. CO_2

Critical Thinking- Answer Key

IDENTIFY DETAILS —
Students will identify the relevant details of a geyser starter that make the geyser reaction occur.

What characteristics do a Mentos mint, table salt, and rock salt all have in common that help to create the geyser reaction when dropped into a soda?

Possible Answer:
The most important characteristic that a Mentos mint, rock salt, and table salt all have in common is that they all have a rough surface. The microscopic pits in each of their surfaces act as nucleation points, which allow the carbon dioxide bubbles to form and begin the geyser reaction.

Critical Thinking- Answer Key

CAUSE AND EFFECT —
Students will identify cause and effect relationships and describe the connection between the carbonation level of the soda and the height of the geyser.

You found an old bottle of soda in the back of the pantry, and you wonder if it would work for this experiment. You know that because it is now flat and has lost most of its carbonation because when you opened it up, hardly any carbon dioxide bubbles floated to the surface. What effect will using this flat soda have on your geyser when you drop the Mentos in?
Explain your thinking.

Possible Answer:
I think that using this flat soda will make my geyser much smaller because there is less carbon dioxide gas to form bubbles at the nucleation points on the Mentos. With less gas there will be less bubbles, and with less bubbles there will not be as much soda shooting into the air. This will probably reduce both the height and duration of the geyser.

Critical Thinking- Answer Key

GENERALIZE —
Students will relate knowledge gained from the experiment/demonstration to other concepts, such as foam in root beer floats.

When making a root beer float, Emir noticed that as soon as he added the ice cream to his glass of root beer that large bubbles or foam started to appear at the top of his glass. Using what you have learned from this demonstration, what is one possible explanation that you could give Emir about why he has so much foam in his root beer float? Use specific details and examples in your answer.

Possible Answer:
I would tell Emir that maybe his root beer float has so much foam because the ice cream has a rough surface with microscopic pits, just like the geyser starters in our demonstration. These pits become nucleation sites for the carbon dioxide that was stuck inside of the root beer so that they can form bubbles. The foam that he is seeing at the top are all of the carbon dioxide bubbles from the root beer that have escaped.

I also think this because I know that if you let the ice cream sit in the root beer, the root beer becomes flat after a short while. The ice cream nucleation points help remove all of the carbon dioxide from the root beer making it go flat more quickly than usual.

Assessment

NAME

ASSESSMENT QUESTIONS —
Read each question carefully and circle the letter next to the correct answer or write your response in the box.

1. Which gas is released from the soda causing the geyser effect?
   a. Helium
   b. Carbon monoxide
   c. Carbon dioxide
   d. Oxygen

2. An effective geyser starter must have a...
   a. small surface area.
   b. rough surface area.
   c. dissolvable shell.
   d. high density.

3. The place where carbon dioxide bubbles begin to build up is called the...
   a. nucleation site.
   b. central molecule.
   c. central nucleus.
   d. geyser site.

4. The geyser would probably shoot highest with...
   a. highly carbonated soda.
   b. non-carbonated (flat) soda.
   c. a lower amount of soda.
   d. a dark-colored soda.

5. Explain why something with a smooth surface, like a marble, would NOT create a geyser effect when dropped into carbonated soda.

   Possible Answer:

   A marble would not create a geyser effect in carbonated soda because it has a smooth surface, which means that there are no nucleation sites for the carbon dioxide bubbles to collect and build.

Common Core State Standards

Student Outcomes	Standards
Students will be able to ask and answer questions about key details about their observations and discussion to demonstrate their understanding of the scientific concepts presented through the experiment.	RI.K.1, RI.1.1, RI.2.1, RI.3.1, RI.4.1
Students will be able to ask and answer questions to help determine the meaning of vocabulary presented as part of an experiment.	RI.K.4, RI.1.4, RI.2.4, RI.3.4, RI.4.4, RI.5.4
Students will be able to explain the connection between scientific ideas presented in the experiment.	RI.1.3, RI.2.3, RI.3.3, RI.4.3, RI.5.3
Students will be able to retell key details presented in the experiment in order to understand/determine the main idea.	RI.K.2, RI.1.2, RI.2.2, RI.3.2, RI.4.2, RI.5.2
Explain the procedure and ideas presented in a scientific experiment including what happened and why, including cause and effect, based on the information presented.	RI.3.3, RI.4.3
Students will participate in shared writing projects and record scientific observations.	W.K.8, W.2.7
Students will be able to use information gained from observations of the experiment to demonstrate understanding of the concepts presented.	RI.4.5
Students will be able to write a narrative that includes details.	W.K.3, W.1.3, W.2.3, W.3.3, W.4.3, W.5.3