MUSEUM OF THE ROCKIES
MONTANA STATE UNIVERSITY

Lesson: Mentos and Diet Coke Geysers

Grade Level: K-12
Activity Duration: 30 minutes

Objectives:

- Students will understand the basic concepts behind how the Mentos and Coke geyser works
- Students will be able to loosely apply these concepts to how Yellowstone's geysers works
- Students will understand the difference between geysers and hot springs

Classroom Materials:

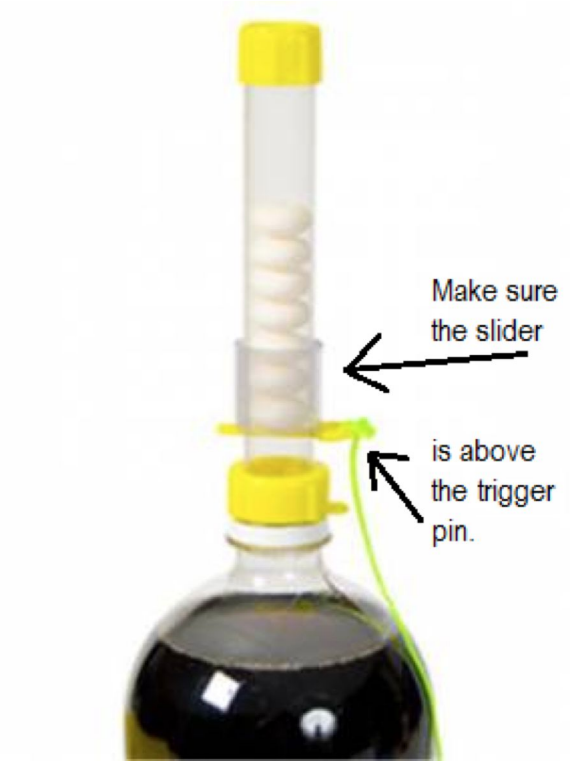
- 1- or 2- liter bottle of soda

Kit Materials:

- Geyser tubes
- Mentos
- Thermal Features diagram

Lesson Procedure:

1. Ask students to create a quick sketch of how they think a geyser works.
2. Find an outdoor location for your geyser. Select a flat surface on the lawn or driveway to place the bottle.
3. Open the bottle of soda and attach a geyser tube.
4. Move the slider up, and put the trigger pin into the hole at the base of the geyser tube.
5. Twist off the top cap on the geyser tube and drop MENTOS® candies into the tube. (You can experiment with different amounts to see what works best!) The trigger pin will keep the candy from falling into the soda before you're ready.
6. Replace the twist-on cap.
7. Warn everyone to stand back. Countdown… 3-2-1… and pull the trigger. The MENTOS will drop and the soda will go flying into the air!
8. Pour out the remaining soda and take a look at the MENTOS®. You can see where the soda has eaten away at the surface of the candy.
9. Have students discuss why they think this occurred! How could the experiment be adjusted?
    a. One variation would be to double or triple the amount of candies that are put into the tube. Is there a way to measure this experiment? What would happen if you just put ½ of a MENTOS into the bottle?



What's Happening?

Here's the question of the day...why does mixing Mentos with soda produce this incredible eruption? You should know that there is considerable debate over how and why this works. While we offer the most probable explanations below, we also understand and admit that other explanations could be possible... and we welcome your thoughts.

As you probably know, soda pop is basically sugar (or diet sweetener), flavoring, water, and preservatives. The thing that makes soda bubbly is invisible carbon dioxide gas, which is pumped into bottles at the bottling factory using tons of pressure. Until you open the bottle and pour a glass of soda, the gas mostly stays suspended in the liquid and cannot expand to form more bubbles, which gases naturally do.

If you shake the bottle and then open it, the gas is released from the protective hold of the water molecules and escapes with a whoosh, taking some of the soda along with it. What other ways can you cause the gas to escape? Just drop something into a glass of soda and notice how bubbles immediately form on the surface of the object. For example, adding salt to soda causes it to foam up because thousands of little bubbles form on the surface of each grain of salt. Many scientists, including Lee Marek, claim that the Mentos phenomenon is a physical reaction, not a chemical one.

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 "surface tension." In other words, water "resists" the expansion of bubbles in the soda.

When you drop the Mentos into the soda, the gelatin and gum arabic from the dissolving candy break the surface tension. This disrupts the water mesh, so that it takes less work to expand and form new bubbles. Each Mentos candy has thousands of tiny pits all over the surface. These tiny pits are called *nucleation sites* - perfect places for carbon dioxide bubbles to form. As soon as the Mentos hit the soda, bubbles form all over the surface of the candy. Couple this with the fact that the Mentos candies are dense and sink to the bottom of the bottle and you've got a double-whammy. When all this gas is released, it literally pushes all of the liquid up and out of the bottle in an incredible soda blast. You can see a similar effect when potatoes or pasta are lowered into a pot of boiling water. The water will sometimes boil over because organic materials that leach out of the cooking potatoes or pasta disrupt the tight mesh of water molecules at the surface of the water, making it easier for bubbles and foam to form.

When a scoop of ice cream is added to root beer, the float foams over for essentially the same reason. The surface tension of the root beer is lowered by gums and proteins from the melting ice cream, and the CO_2 bubbles expand and release easily, creating a beautiful foam on top.

So, How Is This Like a Real Geyser?

To make a real geyser, you need a few things:

1) Heat: Geysers are mostly made of superheated water, so you need a heat source! The geysers in Yellowstone Park have a bubble of magma close to the surface that heats the water. Because the water is under pressure, it can actually become "superheated!" That means that the water in a geyser is actually much hotter than 212°F, which would be boiling if it weren't under that pressure.

2) Reservoir: Geysers need a place to store up superheated water until it's ready to erupt! Underground, there are "caves" that fill up with hot water until the pressure builds up, and then it erupts! If there is no reservoir or "cave," water can't build up. Instead, the superheated water and steam escapes through a small crack, and we have what is called a **Fumarole**. There are many fumaroles in Yellowstone.

3) Plumbing System (the Vent): The Vent is another critical part of the geyser. It has to be just the right size. If the vent is too wide, the hot water won't erupt at all. Instead, it just pools at the surface, and we have a **Hot Spring.** There are many hot springs in Yellowstone as well!

So, are Mentos and Coke geysers like real geysers at all? Sort of! They both have Reservoirs, plumbing systems, and vents. The hot water and steam of a real geyser is simulated by the Mentos. There aren't deep pools of Mentos and Coke under the earth, but it is still a cool and classic demonstration.