

OBJECTIVES

1. Learn about the properties of carbon dioxide, its formation and release
2. Develop a basic understanding of water molecules and surface tension
3. Familiarise with the concept of carbon dioxide and nucleation sites

BACKGROUND INFORMATION

The explosive effect of a Diet coke and Mentos Geyser is due to the sudden release of carbon dioxide coupled with the additive effect of the formation of extra carbon dioxide bubbles on existing nucleation sites on the Mentos.

Carbon dioxide

Softdrink (in this case Diet coke) is made mostly from sugar, flavouring, water and preservatives. The compound that gives softdrink its fizz is invisible carbon dioxide.

This carbon dioxide is pumped into the bottles at the factory using tonnes of pressure. This gas remains suspended in the bottle and cannot expand to form more bubbles (which gases naturally do) until the bottle is opened.

If you shake the bottle before you open it the gas is released from the protective hold of the water molecules and escapes with a sudden blast bringing the softdrink with it. There are other ways you can cause the gas to escape. For example when you drop ice into a softdrink you may notice that bubbles form around the icecube. Adding salt to softdrink will cause the softdrink to foam. This is because thousands of bubbles form on the surface of each grain of salt.

Surface tension

Water molecules strongly attract each other, linking together to form a tight mesh around each bubble of carbon dioxide gas in the softdrink. In order to form a new bubble or expand one 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 softdrink. When you drop the mentos into the coke the gelatin and gum Arabic from the dissolving mentos breaks the surface tension. This disrupts the tight mesh of water molecules allowing them to expand and form new bubbles.

Nucleation sites

Each mentos has tiny pits all over the surface known as nucleation sites. Nucleation sites are places where carbon dioxide can make bubbles. A nucleation site can be a scratch on a surface, a speck of dust, or any place where you have a high surface area relative to volume. Mentos have a lot of imperfections in their surfaces, and that allows lots of bubbles to form. Also, Mentos are heavy enough to sink when you drop them into the bottle, so they react to the softdrink all the way to the bottom of the container.

Why Diet coke works better than regular coke

Sugar molecules are very large and hold onto the Carbon dioxide molecules better than the softdrink without sugar. Therefore sugar does not allow the escape of carbon dioxide to happen as quickly.



MENTOS GEYSER

Mentos Geyser records

The record for the highest Mentos Geyser was set by Steve Spangler in 2005 with an 18 foot blast. The *MythBusters* later set the record highest soda jet recorded, at over 29 feet (9 meters), using a nozzle. The current Guinness World Record of 1,911 simultaneous geysers was set in 2008, by students of The School of Business Administration Turiba in Latvia.

WHAT YOU NEED

- 2L Diet Coke
- 4 mint mentos
- Paper clip
- Spare soft drink bottle lid with ~10mm hole drilled in the centre

WHAT TO DO

1. Note: This activity should be performed outside.
2. Straighten the paperclip. Thread the mentos onto the paper clip and make a small hook at the end so that the mentos do not fall off.
3. Thread the top of the paper clip through the hole in the spare softdrink bottle lid. Bend the paperclip over the top of the lid to prevent the mentos falling into the coke before you are ready.
4. When you are ready, drop the paperclip with mentos into the coke and stand back quickly.

QUESTIONS

1. What would happen if you drank coke and ate mentos at the same time? *The reaction would not be the same as the CO₂ gas would be realised prior to drinking the coke.*

REAL WORLD APPLICATIONS OF CARBON DIOXIDE

Life jackets: Life jackets often contain canisters of pressured carbon dioxide for quick inflation

Fire extinguishers: Carbon dioxide extinguishes flames, and some fire extinguishers, especially those designed for electrical fires, contain liquid carbon dioxide under pressure.

Caffeine removal: Liquid carbon dioxide is a good solvent for many lipophilic organic compounds, and is used to remove caffeine from coffee.

CURRICULUM CONCEPTS ADDRESSED

Essential Learnings: Natural and processed materials

By the end of year 5:

-Materials are composed of smaller parts, some of which may be visible to the naked eye, while others are too small to be seen.

-Properties of materials are affected by processes of change.

By the end of year 7:

-Physical change produces no new substances.

RESOURCES USED TO DEVELOP THIS ACTIVITY

1. *Sticky fun for the Fourth of July.* (2006). Retrieved October 30, 2008, from http://www.smm.org/buzz/buzz_tags/nucleation_sites
2. O'Hare, K. (2008). *The 'MythBusters' Take on the Mentos/Diet Coke Craze.* Retrieved October 30, 2008 from <http://www.zap2it.com/tv/news/zap-mythbustersmentos,0,4325641.story>