Mentos & Soda Car

In the pursuit of science (and records), sometimes things have to get messy... And when you mix Mentos with a fizzy drink, mess is one thing that's guaranteed! Head outdoors and witness one of the coolest reactions you'll see beyond the lab.

THE RECORD: Farthest distance by a Mentos and soda bottle vehicle

THE CHALLENGE: Build some kind of "car" (we're talking in its most basic form, so a platform with four wheels). Then use the explosive power of Mentos mixed with soda to propel it as far as it will go.

Surprisingly, the easiest thing about this record is setting off the Mentos and soda reaction (we've used diet cola).

The more complicated elements are creating a stable vehicle that doesn't fall apart a few centimetres into its journey (trust us, it'll happen), finding a bump- and obstacle-free stretch of ground (harder than it sounds) and getting the car down on the floor *before* you get a face full of soda!

WE USED:
- SODA BOTTLE
- JAR LIDS
- FIDGET SPINNERS
- PLASTIC TUBES
- PLASTIC TUB
- CABLE TIES
- COPPER WIRE
- MENTOS

SHOPPING LIST

GUIDELINES

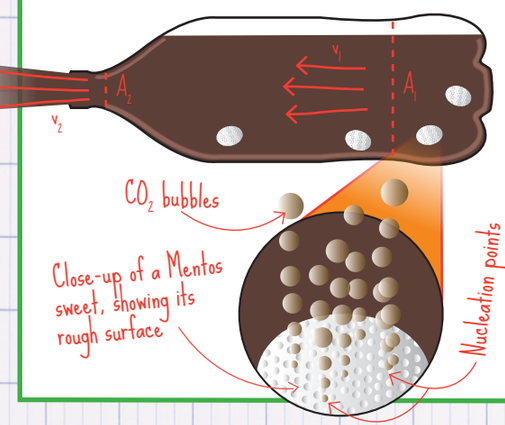
- The vehicle can be of any design, but must have four wheels and be propelled *solely* by a Mentos and soda fountain. Part of the challenge is finding the best design.
- A start line must be marked on the ground where the attempt takes place. The surface the car travels on must be flat, reasonably hard and level – no slopes allowed!
- There must be no interference with the vehicle once the attempt has begun. If the vehicle hits any object during the journey, the attempt is disqualified.
- A clear video of the complete record attempt and measuring process must be submitted as evidence.
- The distance must be measured in a straight line from the start line to the closest edge of the vehicle once it has come to a rest.

The fluid continuity equation: basically, when a moving fluid is forced through a tight space – such as a hole in a soda bottle cap – it will speed up

HOW DOES IT WORK?

$A_1v_1 = A_2v_2$ $\quad 0.006362\ m^2 / 0.0000785\ m^2 = 81\ m^2\ (\times 0.08432\ m/s)$

$v_2 = 6.83\ m/s\ (24.6\ km/h;\ 15.3\ mph)$



The reason that soda is so bubbly is because carbon dioxide gas (CO_2) is pumped in to give the drink its fizz. The CO_2 binds to the water molecules (H_2O) in the soda, but only lightly. It doesn't take very much for the CO_2 to escape; that's why the drink always foams up when you take off the lid – and also why record-breaking burpers swear by it (see pp.126–27)!

One thing that can speed up the release of the CO_2 is dropping something into the soda. At first glance, Mentos appear smooth, but under a microscope (see inset) you'll find that their surface is covered in tiny bumps and pits.

The suspended CO_2 is able to break away from the water molecules by forming bubbles on another surface – a process known as "nucleation". That's why you always see a few bubbles clinging to the inside of the soda bottle. Despite their small size, the rough-coated Mentos sweets provide a huge surface for lots of bubbles to form very quickly.

This sudden build-up of foamy liquid has to go somewhere and, naturally, it seeks to get out of the bottle. Forced out of the narrow neck means it comes out at high velocity, thanks to the wonders of fluid continuity (see equation left). That's what *should* give your bottle car its propulsion.

TIL
TODAY I LEARNED
Many people assume that the explosive reaction between Mentos and soda is a result of chemistry. But it's actually down to physics. The rough texture of the sweets provides the perfect surface for lots of bubbles to form very quickly (see more in "How Does It Work?" above).

Maybe we'll be driving life-sized Mentos-soda cars one day...

Probably not...

Mentos & Soda Car (continued)

Start by making the main chassis of your "car". You want to strike a balance between weight (keep it as light as possible) and strength (it needs to be able to support a full bottle of soda without getting crushed). We opted for an empty plastic tub, but you could use anything from lolly sticks to LEGO bricks – just run it by GWR's records team first. Very carefully cut the top off (**1**) until you're left with just the shallow base of the box (**2**); the lower to the ground that the bottle sits, the more sturdy the vehicle will be. Next, glue on your axles (**3**) – we've used a couple of plastic tubes originally used to hold vitamin tablets.

With the axles attached to the chassis (**4**), it's time to turn your attention to the wheels. It's worth really thinking about your wheel design because success hinges on them turning freely – and not falling off! We dusted off some old fidget spinners (these toys are built for rotating, just like wheels) and glued them inside some jar lids (**5**). Then we glued the spinners to the axles (**6**); take care not to get any glue on the ball bearings in the centre as this will stall your car before it even gets started.

Ideally, you want the nozzle to point slightly downwards to get the most out of Newton's Third Law (i.e., the foam jet pushing against the ground)

To stop your bottle tumbling off when your car (hopefully!) speeds away, add a cable tie or two to secure it in place.

TOP TIP!
FROM PROFESSOR ORBAX

To help our car travel farther, we added some rubber bands to the rims of the jar lids. These are essentially performing the same role as the rubber tyres covering the wheels of your family car or bicycle. *Traction* is the friction that occurs between the wheels and the ground, ensuring the car "bites" into the road. This resistance enables a vehicle to transfer rotational energy from the axles (torque) and turn it into forward motion. No matter how powerful your Mentos-soda fountain is, if your wheels aren't gripping the ground, the car won't go very far.

Place a lump of Plasticine/modelling clay on a flat surface and use it to carefully poke a hole in the lid of your bottle. You might need to adjust the size of this to get the most efficient stream, but it's best to start small; after all, you can always make it bigger, but not vice versa.

A stretched-out paperclip will also do the trick

Rather than dropping the Mentos in one at a time, which will set off the reaction before you're ready, it's best to create a pre-formed string; six to eight sweets should do it. We poked holes through the middle, then threaded them on to a piece of copper wire.

Pour out just enough of the soda so that you can suspend your string of Mentos through the lid without them touching the liquid. With the bottle still standing up, screw the cap back on. Keep a tight hold on the wire or you'll get an unwanted soda shower! When you're ready to roll, drop all the Mentos in and lay the car flat, pointed in the general direction you'd like it to travel.

THIS is why this record should be done outdoors

Don't handle the Mentos too much or you'll rub off the rough surface

We used diet cola, but try a few different types of soda to see which one works best!

As the size of the hole increases, so does the size of the stream; but for power and duration, you'll need a smaller aperture