

TONIC WATER FOUNTAIN
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INTRODUCTION:

Are your students tired of hearing about the Mentos Fountain?
Try this dramatic variation, based on a mean-spirited college pub trick.

CHEMICAL CONCEPTS:

Henry's Law, Fluorescence, UV Light, Inertia

MATERIALS:

Diet Tonic water in a plastic 1L or 2L bottle
2"x2" "whacking stick" about 30-45 cm long
Shallow, wide pan to catch the liquid
Ultraviolet lamp, black shirt, room that can be darkened
Goggles that absorb UV light for the instructor
Splash-proof goggles for some of the students
Optional: a leather "work glove" for holding the bottle.

PREPARATION:

1. Drill a $\frac{1}{4}$ " (6mm) hole in the cap of an empty 2L soda bottle. Use the bottle as support while you drill first a smaller guide hole, then the 6 mm hole.
2. Just before the demonstration, crack the seal on a fresh, room temperature bottle of Diet Tonic Water. Release the gas as slowly as possible. When the pressures are equalized, remove the cap.
3. Screw the drilled cap onto this bottle and place a shallow wide pan on the floor to catch the overflow liquid.
4. Put on a black T-shirt over your clothes to avoid fluorescence from your shirt distracting from the event.
5. Obtain a 2" x 2" "whacking stick" about 30 – 45 cm long
6. Check your goggles to be sure they absorb UV light by illuminating a sheet of white paper. Place the goggles between the source and the paper. You should see a very distinct shadow of the lenses on the fluorescent paper.
7. Position yourself so that you are not under an electrical light or other device on the ceiling.

SAFETY:

Safety glasses are required for the demonstrator and the "lighting technician", of course. In this case, the students in the front rows should also be wearing them. Have a mop handy to dry the soon-to-be-slippery floor. Using Diet Tonic Water avoids the mess of cleaning up a sugar solution later. Be careful that the fountain will not contact electrical equipment (lights, detectors etc.) on the ceiling.

DEMONSTRATION:

Make your classroom as dark as possible. Have a student stand to the side of the display area holding a UV light, shining it on you in an area away from the seated class. Have a significant distance between the bottle and the front row of students so that they will not be splashed. Talk about the fluorescence visible in the bottle of Tonic Water while holding the bottle. Grip it ONLY by the cap and bottle-neck. Casually pick up the stick and bring it down forcefully on the cap of the bottle.

***Practice this in a darkened room!
Hit the cap, not your fingers or wrist!***

The bottle will move down, quickly releasing gas at the bottom of the liquid and forcing a fountain out through the drilled hole. If you are lucky, the tonic water will hit the ceiling and drip down onto your black T-shirt. Seeing the teacher's hair, face and clothing covered in glowing blue droplets seems to be a popular event. Watching blue blobs drop from the ceiling tiles is even more popular! When the room lights are turned back on, it all looks like water!

DISCUSSION:

The Tonic water contains Quinine hydrochloride that fluoresces in UV light. When hit sharply, the bottle moves downward, but the liquid remains in place (inertia), creating a low-pressure area between the bottom of the bottle and the liquid. The low pressure allows CO₂ gas to escape from the liquid (Henry's Law). With the liquid at room temperature, this release of gas is dramatic. The resulting pressure pushes liquid up through the drilled hole in the cap.

(Note: if you try to hold the bottle not just the neck, the thin plastic neck will collapse and absorb the shockwave, leading to poor results.)

The event spawns much discussion even without mentioning the pub-related trick. I found it especially useful to "break the ice" if students have been under pressure. Being able to laugh at the teacher with blue liquid running all over him seemed very therapeutic for class morale. Sometimes they need evidence that, although you take science seriously, you are still willing to laugh at yourself.

(Aside: Quinine Hydrochloride is a controlled substance, so is not available other than in Tonic Water. Fluorescein is readily available if you want to explore UV fluorescence with your classes. Long wavelength UV lights are cheap if you buy Compact fluorescent "Black Light" bulbs from Canadian Tire or other hardware/building supply store.)