

# Diet versus Regular Soft Drinks

Cans of soft drinks are so common that many people have done much of this exploration without realizing it. You, too, have probably cooled soft drink cans in ice water for a picnic. Here is your opportunity to see if you can make some generalizations about their behavior in water.

## Materials

- 1 12-fl oz (355 mL) aluminum can of diet soft drink, unopened
- 1 12-fl oz (355 mL) aluminum can of regular (non-diet) soft drink, unopened (use same brand as the diet soft drink if possible)
- container of water large enough to totally submerge both beverage cans in an upright position
- measuring cup calibrated in mL
- (if available) plastic, glass, or steel containers of diet and regular soft drinks of equal volumes, unopened (Use containers made of the same material.)

## Safety

Do not use water hotter than that from the tap since very hot water can cause the containers of soft drinks to explode, as well as cause severe burns.

## Exploration

- Step 1 Holding the unopened cans in an upright position, submerge both cans in the container of water. Let go and record their orientations and whether they sink or float.
- Step 2 Repeat Step 1, but release the cans in a horizontal position. Record your observations. Explain any changes in orientation of the cans.
- Step 3 What property of matter accounts for the cans floating or sinking? How does this property differ for each soft drink can? If each container is made of aluminum and occupies the same volume, what do your observations say about the mass of the contents? Read the content information on the cans. What, if any, are the differences in ingredients?
- Step 4 With the measuring cup, measure the volume of the liquid in each can. How do these volumes compare to the volume of the can? How do you think the densities of the liquids compare? What would have to be done to determine the densities of the liquids?
- Step 5 Completely fill the cans with water. Submerge them in water and record whether they sink or float. Look up the densities of water and aluminum in your textbook. How do these values contribute to the behavior of the cans of beverages?
- Step 6 If materials are available, repeat Step 1 using plastic, glass, or steel containers of diet and regular soft drinks of equal volumes. Does the composition of the container make a difference in its floating/sinking behavior? Compare and contrast the results with those obtained for the aluminum cans.

## Challenge

What factors account for the differences in density observed?

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## Concept

density

## Expected Student Responses to Exploration

Step 1 The diet soft drink floats in an upright position; the regular soft drink sinks in an upright position.

Step 2 (a) The cans switch to an upright position.

(b) Because of its lower density, the CO<sub>2</sub> gas within the cans will always stay on top of the liquid. A can is not well-balanced enough for the gas to remain along a side. It will always go to its upright position.

Step 3 (a) Density is the property responsible for the cans floating or sinking.

(b) The regular soft drink can with contents is more dense than water; the diet soft drink can with contents is less dense than water (and less dense than the regular soft drink).

(c) The mass of the regular soft drink is greater than the mass of the diet soft drink.

(d) The regular soft drink has “high fructose corn syrup and/or sugar” (or a similar ingredient) in second position; correspondingly, the diet soft drink has “Nutra Sweet brand of aspartame” in about the fourth position.

Step 4 (a) The volumes should be about 355 mL.

(b) The volumes should be just a little less than the volumes of the cans.

(c) The regular soft drink must be more dense than the diet soft drink.

(d) To determine the densities of the liquids, their masses would have to be measured and those values divided by their volumes.

Step 5 (a) Both cans, when filled with water, sink.

(b) The density of aluminum is 2.7 g/mL and the density of water is 1.0 g/mL.

(c) Considering just aluminum and water, both cans of soft drink should sink.

Step 6 Both glass containers and both steel containers sink; both plastic containers float. The composition of the container makes a big difference. Glass and steel are too dense to be compensated by the small amount of gas in the container to allow the soft drink container to float. Not only is the density of the plastic PETE (1.4 g/mL) about half the density of aluminum, soft drinks in plastic containers have much larger volume of “gas” than cans.

## Expected Student Answer to Challenge

An aluminum can of diet soft drink floats in water. An aluminum can of regular soft drink sinks. The primary factor in the different floating/sinking behaviors is the greater amount of sweetener in the regular soft drink.

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