3. **Conservation of mass** (grade 5 or earlier). The learning outcome for students with this activity is that mass is always conserved in every situation. The activity described here is just one small aspect of this, and I encourage you to address the conservation of mass in as many science activities as you can. This is one of the big ideas that has central utility in all areas of science. There is also a second learning outcome, and that is that gases always have mass. Unless the mass of gas is taken into account, some changes seem to involve either the loss or the gain of mass, violating the principle that mass is always conserved. A final learning outcome with this activity is that science often depends on appropriate use of mathematics. Because math is such a central part of the elementary curriculum, this (and the following activity) is a good place to reinforce math skills.

There is a little set-up that is not difficult. You will need for each group of students (3-4) one 20 oz plastic soda bottle with lid (plastic water bottles will NOT work!). You will also need some sodium carbonate. You can find this either in the detergent aisle listed as “washing soda” or in the swimming pool aisle listed as “pH Plus” or something similar. Just read the label and it should say “100 % sodium carbonate.” It is quite cheap, and a container will last you for years. Baking soda is not the same thing. It works OK, but not really as well. You will also need vinegar. You will need an electronic scale, 200 gram capacity with a precision of 0.1 g. More precision is not helpful! You can get these from OHaus (CS series) for about $100. Every classroom should have one! You will also need small graduated cylinders (plastic, 100 mL capacity, obtained at hobby stores), and 4-inch tissue squares (cut a Kleenex sheet into squares).

You should instruct students into the proper use of the electronic scales, or else do this step yourself. In particular be sure the scale is zeroed each time it is used. Have students pour 20 mL vinegar into their pop bottles and weigh with the lid, then record this mass in their notebooks. They should then place the tissue on the scale and weigh onto it about 5-6 grams of the sodium carbonate (transfer with a plastic spoon). Record the total mass of the sodium carbonate plus the tissue. In their notebooks, they should add the mass of the bottle plus vinegar with the mass of the sodium carbonate plus tissue. This should be labeled as “total initial mass of the system.” Tightly wrap the tissue around the sodium carbonate into a “burrito” small enough to just fit into the mouth of the bottle. Very carefully, hold the bottle completely horizontally, and place the burrito into the mouth so that it does not touch the vinegar, and screw the lid on very tightly. Holding the system horizontally, place it on the scale and verify that its mass is the same as calculated in the notebooks. Now place the bottle upright and tap gently to get the burrito and its contents to mix with the vinegar at the bottom. Don’t remove the lid! Observe a chemical reaction taking place at the bottom (listen, watch, and feel the temperature change). As the reaction subsides, weigh the bottle again and observe its mass (it should be the same as before). Now, quietly release the lid and listen for the whoosh of escaping gas. Weigh the bottle again and see what happens to the mass. The drop in mass is the mass of the gas that escaped.

Conversation after this activity should be about two major points – what is the evidence that mass is conserved during a chemical reaction (including the evidence that a chemical reaction took place), and what is the evidence that the gas that formed has mass. In addition, you can discuss with students ways that math plays an important role in showing that mass is conserved.