

When Does the Fizz Stop? A Reaction as a System

Investigation question: If you keep adding more baking soda to the same amount of vinegar, does the reaction keep making more gas forever, and what decides when it stops?

Collaborative systems modeling

Groups of 3

1 session

Setup 7 · Activity 40 · Cleanup 6 min

MS-PS1-2 · practice

MS-PS1-5 · supports

Name _____

Group _____

Date _____

Your role today

- ☐ **Balance operator:** Zeroes the balance with the empty cup, weighs the vinegar and each baking soda portion, reads the final mass, and keeps the balance dry.
- ☐ **Reactor:** Adds the baking soda portion all at once, swirls the cup gently every 30 seconds, runs the leftover test, and rinses the cup between runs.
- ☐ **Recorder and modeler:** Records every mass, computes the mass lost, times the run, plots the point as soon as it is known, and leads the box-model drawing.

Safety

- Splash goggles on throughout; vinegar stings eyes and foam can spatter when the larger portions go in.
- Never cover, cap or seal the cup while it is fizzing; the gas must leave freely. Nothing is tasted.
- Keep the balance dry: lift the cup off before adding baking soda if foam might spill, and wipe any drips at once.
- All liquids go down the sink with running water at the end; the cups are rinsed between runs, not sealed.

Procedure

1. Goggles on. Put the empty wide cup on the balance and zero it. Add 50 mL vinegar and record the mass of the vinegar.
2. Weigh the first baking soda portion (1.0 g) on a paper square and record its mass. Add the vinegar mass and the portion mass to get the starting total.
3. With the cup on the balance, tip the whole portion in at once and start the timer. Swirl gently every 30 seconds. Watch the bubbles.
4. When no bubbles have risen for 30 seconds, read the mass of the cup and contents. Mass lost = starting total minus final mass. Record the time the fizz took.
5. Leftover test, part 1: add a pinch of fresh baking soda to the liquid. Record fizz or no fizz. Part 2: in the same cup, add 1 mL (about 20 drops) of fresh vinegar. Record fizz or no fizz. Decide which reactant was

used up and record it.

6. Pour out, rinse the cup, dry the outside, and repeat steps 1 to 5 with 2.0, 3.0, 4.0, 5.0 and 6.0 g of baking soda, always with a fresh 50 mL of vinegar.
7. Plot mass lost (vertical) against baking soda added (horizontal) as each run finishes. Draw a smooth line through the points.
8. Draw the box model: the cup as a system, with arrows for what goes in, what leaves, and what stays, and label which arrow the balance measured.
9. Use the model and your graph to make the two predictions on the recording sheet before you answer the analysis questions. Pool class data on the board.

Record your observations

Lab 3 recording sheet: When does the fizz stop?

Record every mass to 0.1 g (or 0.01 g if your balance reads it). Mass lost = (vinegar + baking soda) minus the final mass of the liquid in the cup. Run the leftover test after every run.

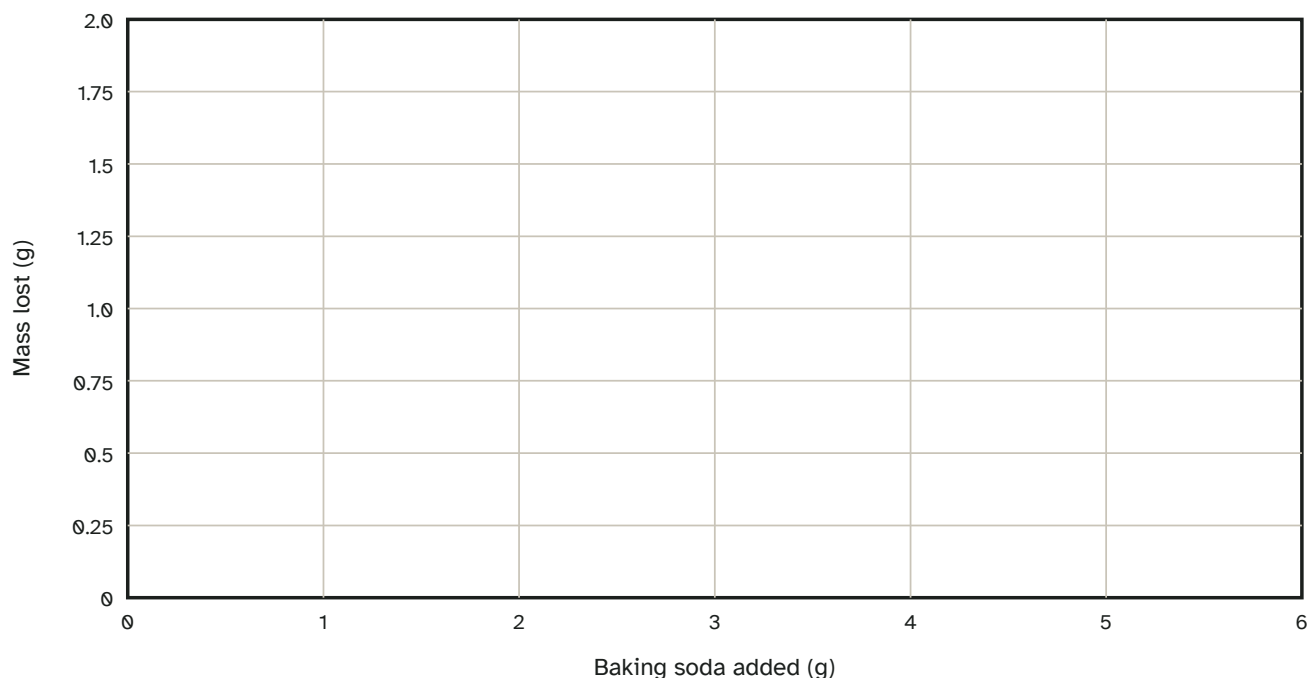
Mass data

Baking soda added (g)	Vinegar mass (g)	Starting total (g)	Final mass (g)	Mass lost (g)	Time until fizz stopped (s)
1.0					
2.0					
3.0					
4.0					
5.0					
6.0					

Leftover test

Baking soda added (g)	Pinch of baking soda added: fizz?	1 mL vinegar added: fizz?	Which reactant was used up?
1.0			
2.0			
3.0			
4.0			
5.0			
6.0			

Mass lost against baking soda added (50 mL vinegar)



-  Draw the cup as a system. Show a box for the cup, an arrow in for the baking soda, an arrow out for what leaves, and labels inside for what stays behind after the fizz stops. Mark the arrow the balance measured, and show how the box changes between a small portion (1 g) and a large portion (6 g).

1. Prediction 1: 100 mL of vinegar with 3.0 g of baking soda. Mass lost = ____ g. Explain using your model.

2. Prediction 2: 25 mL of vinegar with 4.0 g of baking soda. Mass lost = ____ g. Explain using your model.

Analysis questions

3. Describe the shape of your graph. Between which two amounts of baking soda did the line stop rising, and what happened to the mass lost after that?

4. Use the leftover-test rows to say which reactant was used up for the small portions and which for the large portions. How does that explain the bend in the graph?

5. Where did the lost mass go? Is 'the cup got lighter' evidence that a new substance formed? Combine it with the leftover test to make the argument.

6. For the 2.0 g run, work out how much mass was lost per gram of baking soda. Then use that rate to predict the mass lost for 2.5 g of baking soda in 50 mL vinegar, and say why the same rate would give the wrong answer for 5.0 g.

7. A classmate says the fizzing stopped because 'the reaction ran out of energy.' Use two results from this lab to show why that explanation does not fit the data.

8. Your measured plateau was probably a little below the value the teacher's key predicts. Give two reasons the measured mass lost could be lower than the mass of gas the reaction actually made.

9. What does your box model show well, and what does it leave out? Name one thing about the reaction that the model cannot tell you.
