

# Wait, weight, don't tell me!

## *Having a gas with the conservation of mass*

### Introduction:

Can a simple chemistry activity disprove “The law of conservation of mass?” Is there something wrong with the laws of nature? Find out by doing this activity.

This activity can also be used for investigation into the following NGSS Crosscutting concept:

- *Cause and effect: Mechanism and explanation.*
- *Systems and system models.*
- *Energy and matter: Flows, cycles, **and conservation.***

### Materials:

- Baking soda
- Vinegar (Standard 5% acetic acid)
- A Balloon
- A Bottle or flask
- A Balance scale that reads to at least 0.1 gram
- Optional:  
This activity is meant to spark more experimentation.

Have a variety of supplies on hand to allow investigation into this phenomenon.

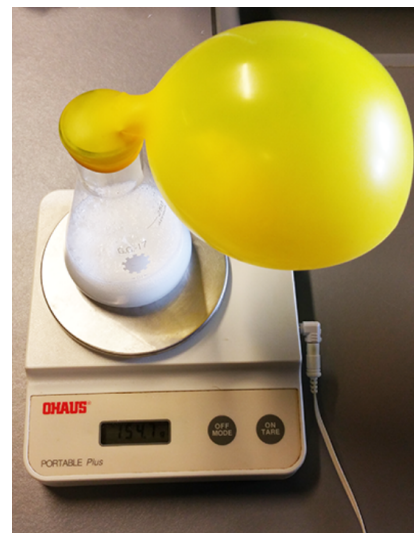
### Assembly:

*Note: Remember to always use caution when working with chemicals and wear your safety goggles.*

1. Attach a balloon to the end of the funnel.
2. Using the funnel, pour into the balloon a few grams worth of baking soda (not more than 10 grams).
3. Make sure the funnel doesn't clog and all baking soda passes through the neck of the balloon.
4. Pour about ½ a cup of vinegar in the bottle or flask.
5. Attach the balloon to the flask.
  - a. Make sure none of the baking soda spills into the vinegar
  - b. Hang the balloon off to the side of the flask.

### To do and notice:

1. Read and record the weight of your sealed setup/container.
2. Before tipping the balloon's contents into the flask....take a guess what will happen. What numbers will the scale read? Will they:
  - a. Go down
  - b. Go up
  - c. Stay the same
3. Lift and empty the baking soda into the flask. Making sure all of the powder get into the flask.
4. Stand back and watch the balloon grow.



5. Observe the scale as the reaction slows.
6. Record this data when the reaction stops.

#### What's going on?

Did the weight go down, up or stay the same?

#### **What????**

It went down! How did this happen?



#### Going Further:

Weight, weight, don't tell me!

At this point, continue reading or try doing more investigations.

Come up with a list of possible explanations/ reasons this result happened.

1. Could it be your container leaked?
2. Did the temperature changed dramatically?
3. Was the scale wrong?
4. What else could it be?

Grab some equipment and try investigating these questions.

#### What's going on?- continued

Ok, here's the answer- The volume changed!...that's it!

Gas (carbon dioxide) was generated by the chemical reaction of combining baking soda and vinegar. The gas filled and expanded the balloon. Because of this enlargement, the whole setup/container weighed less....**in air**.

Just like water, air is a fluid. You and the container are submerged in air. Because of pressure differences, fluids have the ability to buoy up objects. The mass of your setup didn't change (conservation of mass), but the volume did. In essence, making your container less dense and easier to be buoyed up by the surrounding air.

Your scale measures weight, not mass. After inflation, your container presses down with less force on the scale. Actually, your scale will read less by the amount of fluid (in this case air) displaced by the expanded balloon - This is **Archimedes'** principle in action! You can figure out how much less your container will weigh by knowing how big your balloon got.

#### Going Further:-continued

Here are some other concepts this activity can be used for:

- Gas as a fluid
- Buoyancy
- Density
- Chemical and physical change
- Engineering
- Variables
- Open and closed systems
- Mass vs. weight
- Measurement
- And more.....

Credit: The idea for this activity was first introduced to me by Eleanor Duckworth of Harvard University.