Law of Conservation of *Mass*

"Matter is neither created nor destroyed"

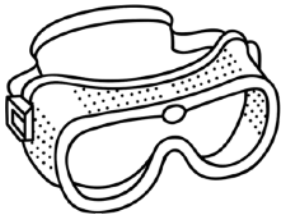
Antoine Lavoisier is credited with discovering that *matter is neither created nor destroyed* during a chemical reaction. The mass of the chemicals before the reaction (reactants) is equal to the mass of the chemicals after the reaction (products). You will conduct an experiment to prove (or disprove) Lavoisier's discovery.

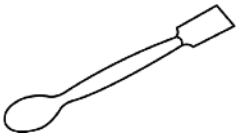
Experiment: Reaction of Acetic Acid and Sodium Bicarbonate in a *Closed System*

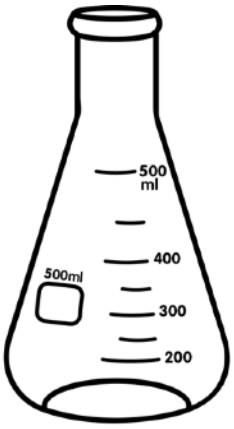
$HC_2H_3O_2$ (Acetic Acid (Vinegar)) + $NaHCO_3$ (Sodium Bicarbonate (Baking Soda)) → $NaC_2H_3O_2$ (Sodium Acetate) + H_2O (Water) + CO_2 (Carbon Dioxide Gas)

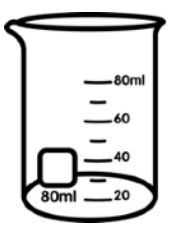
Materials:

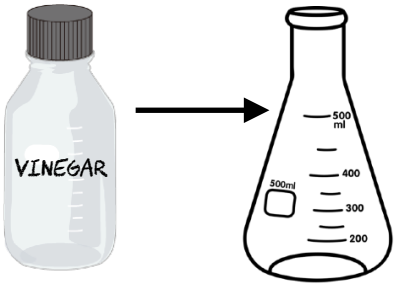
500 ml Erlenmeyer Flask (or equivalent)
100 ml Beaker
funnel
goggles
balloon (about 12" diameter)
Spoon or scoop
digital balance
pin or needle
Baking Soda
Vinegar





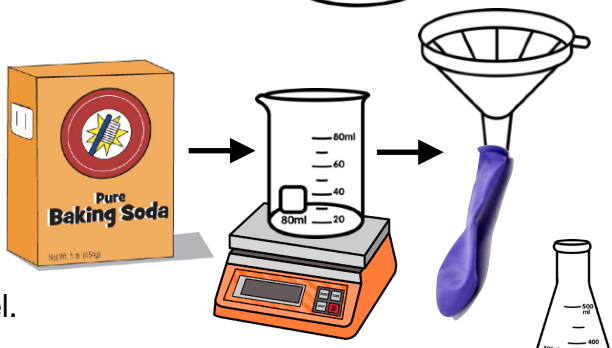






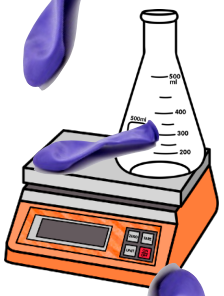
Do This:

1. Add about 100 ml of Vinegar to the Erlenmeyer flask.

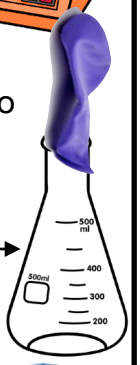


2. Add about 10 g of Baking Soda to the Beaker.
   Hint: Place the empty beaker on the balance and tare (zero out) the balance before adding Baking Soda.

3. Pour the Baking Soda into the balloon using the funnel.



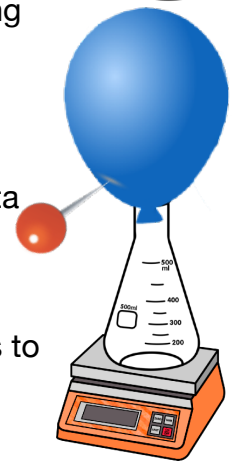
4. Place the flask of Vinegar and the balloon filled with Baking Soda on the balance. Record the *Total Mass before reaction* on your data chart. Note: it's o.k. that you are including the mass of the flask and balloon.



5. Remove the Flask and balloon from the balance. Fit the balloon over the top of the flask to form a tight seal. **Don't let any baking soda to spill into the flask** (just yet)**.** This is a "closed system" apparatus because no gasses are allowed to enter or leave.

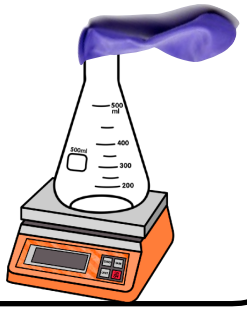
Closed System apparatus →

6. Now for the *fun* part. Lift the balloon to allow the baking soda to fall into the flask of vinegar. You can tilt the flask upside down a few times to thoroughly mix the Baking Soda and Vinegar. Record your observations on the data chart.



7. When the reaction stops, zero out the balance and place the apparatus (flask with attached balloon) on the balance. Record the *Total Mass after reaction* on your data chart.

8. Leaving the balloon attached, poke a hole in the balloon with a pin to allow the gas to escape. Squeeze the balloon so no air reenters the flask.



9. Place the apparatus with the empty balloon back on the balance and record the *Total Mass without gas* on your data chart.

DATA CHART	**MASS** g	**Observations**
Total Mass BEFORE reaction		
Total Mass AFTER reaction		
Total Mass without gas		

Analysis:

1. How did the mass of your Closed System **before** the reaction compare to its mass **after** the reaction?

2. How did the mass change after the gas was released from the balloon?

3. Describe all that happened when the Baking Soda reacted with the Vinegar?

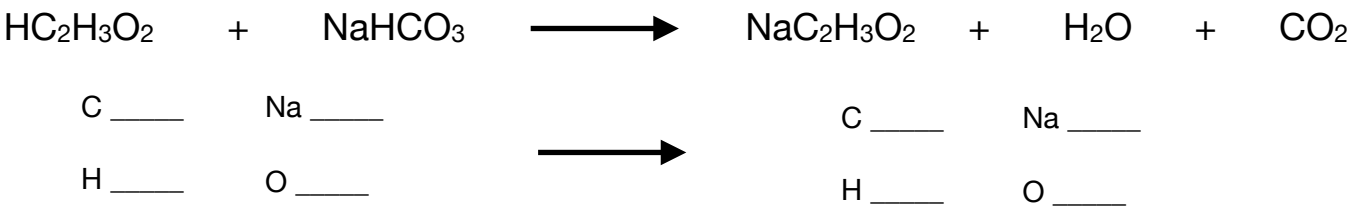
4. What is the name of the gas produced in the reaction?

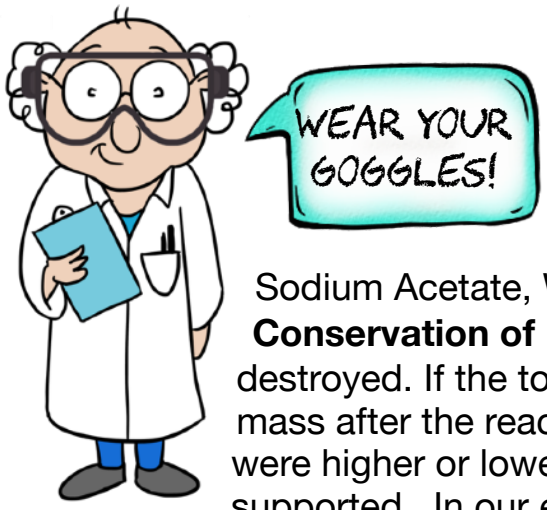
5. What two substances were produced in the flask (in addition to the gas)?

6. What was the approximate mass of the CO_2 gas produced? Was there enough to accurately measure?

7. Does your experimental results support the Law of Conservation of Mass? Explain.

8. Is the equation for the chemical reaction balanced? Hint: count the number of atoms of each element on both sides of the equation (and write them in the spaces below).





Teacher notes and lab setup:

The reaction of Baking Soda and Vinegar produces Sodium Acetate, Water, and Carbon Dioxide gas. The **Law of Conservation of Mass** tells us that matter is neither created nor destroyed. If the total mass before the reaction is the same as the total mass after the reaction, the Law would be supported. If the final mass were higher or lower than the starting mass then the law would not be supported. In our experiment, the final mass should be the same as the starting (or within the limits of our ability to measure) as long as the Carbon Dioxide Gas were not allowed to escape. When the balloon is popped allowing the gas to escape, the mass of the system (minus gas) should be slightly less than the starting mass. Depending on the accuracy of measurement and the sensitivity of your balance, you may or may not be able to measure the amount of Carbon Dioxide gas produced.

Lab Setup:

You may find that your students are not all ready to do the lab at the same time. Because of this, you may want to have 4 or 5 lab setups for students to help themselves when they are ready. Some students may be working assembling and completing the Infographic and still others working on other labs or activities within the lesson.

Each Setup:

500 ml Erlenmeyer Flask (or equivalent)
- 100 ml Beaker
- funnel
- goggles
- balloon (about 12” diameter)
- Spoon or scoop
- digital balance
- pin or needle
- Baking Soda
- Vinegar

If an Erlenmeyer Flask is not available, any container with a narrow opening for the balloon to fit around will work.

Students should wear safety goggles and follow all safety precautions when handling Baking Soda and Vinegar. Students should be discourage from putting balloons in their mouth, just tell them you saw a kid chewing on it earlier. That should do it!