

Baking Soda and Vinegar Experiment

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Science

Standard I: Students will understand that chemical and physical changes occur in matter.

Objective 1: Describe that matter is neither created nor destroyed even though it may undergo change.

Indicators d: Investigate chemical reactions in which the total weight of the materials before and after reaction is the same. (e.g., cream and vinegar before and after mixing, borax and glue mixed to make a new substance.)

Objective 3: Investigate evidence for changes in matter that occur during a chemical reaction.

Indicator a: Identify observable evidence of a chemical reaction (e.g. color change, heat or light given off, heat absorbed, gas given off.)

Indicator b: Explain why the measured weight of a reminting product is less than its reactants when a gas is produced.

Science Intended Learning Outcomes

1- Use science process and thinking skills—f, g, h, i

6- Understand the Nature of Science—c

Background Information:

A *chemical change* occurs when new kinds of matter are formed. The composition of the matter changes and the new kinds of matter have different properties from the old matter. Evidence of a *chemical change* may be the result of chemicals reacting with one another. A *gas* or a *solid* may be formed where the *products* are in a different state than the *reactants*. A change in temperature, pressure, or color may also be evidence of a *chemical change*. These changes are called indicators. Physical properties, such as the boiling point and the melting point, are often altered as matter undergoes a *chemical change* (e.g., a raw egg when cooked becomes a hard-boiled egg).

Materials:

- 16 oz plastic soda bottle
- Funnel
- Balloon
- Balance
- Vinegar
- Baking Soda
- ml spoon
- Graduated cylinder

Procedure Discussion

1. Discuss the Law of conservation: Matter is neither created nor destroyed. The matter only changes form.
 - a. When substances are mixed, whether there is a physical change or a chemical change, the weight of the substances added together will always equal the final weight of the final substance(s).
 - b. Matter is a physical substance which occupies space and has mass.
2. Matter can go through changes. It can go through a physical change or a chemical change.
 - a. A physical change is when it changes in form but not what it is made of.
 - b. A chemical change is when two or more substances (matter) are combined and they react with each other and they change into new substances.
3. Talk about that there are evidences that are evident when substances go through a chemical change.
 - a. A new solid is formed.
 - b. A new liquid is formed
 - c. Change of temperature (hot or cold)
 - d. Light is given off
 - e. An unexpected gas is given off
 - f. An unexpected odor is given off
 - g. An unexpected color change
 - h. Combustion of material
4. Tell the students that we are going to do an experiment that involves a chemical change. We are going to follow a scientific process when doing this experiment. Pass out the paper to do The Scientific Method on.
5. Have the students fill out the question:
 - a. Is adding backing soda to vinegar a chemical change or a physical change?
6. Give them some background information about the two substances
 - a. Below is the chemical makeup of baking soda and vinegar:
Baking soda + Vinegar
 NaHCO_3 + $\text{HC}_2\text{H}_3\text{O}_2$
 - b. There are 14 atom particles in all.
7. Tell the students that when there is a chemical change, all the atom particles break away from each other like breaking apart Legos and laying them all out on a table. Write them out:
 $\text{H C C H H H O O Na H C O O O}$
8. When they are lying out like that, they like to find new atom particles to attach to and therefore creating new substances. We are going to see if baking soda added to vinegar will make new substances. We will know if they are combining to

make new substances if there are evidences of it from the knowledge we know about the indicators of chemical changes.

9. Have the students make a prediction as to what they think will happen when the two substances are mixed.

Procedure Experiment

1. Put the students in groups of two's or three's. As you are talking about the procedure and the materials, have them write it down in the procedural and materials part of the Scientific Method paper.
2. Have the students put the end of a funnel in the mouth of the balloon and measure out 10 ml of baking soda and put it in the funnel so the baking soda will go into the balloon. Have the students weigh the balloon with the baking soda in it and record it.
3. Have the students measure out 25 ml of vinegar into a graduated cylinder. With a funnel, pour it into the 16 oz plastic soda bottle. Have the students weigh the bottle with the vinegar in it and record it.
4. Carefully put the mouth of the balloon over the mouth of the soda bottle without letting the baking soda get into the bottle.
5. When ready, have the students lift up the balloon so the baking soda goes into the bottle. Shake the balloon so it all falls into the bottle. Shake the bottle so that the baking soda mixes well with the vinegar. Have them record on their data sheet what they observed happening. (It fizzed, there is a liquid, there is a solid, it is cold on the bottom, and there is a gas in the balloon.)
6. When they are done, have them discuss and write down on the "analyze section" as a small group what indicators they saw to know if it was a chemical reaction.
7. When they are done with that, discuss as a class what they came up with.
 - a. A new solid was formed.
 - b. A new liquid was formed.
 - c. A new gas was formed.
 - d. There was a temperature change.
 - e. There was combustion.
8. If we were to send this to a chemist, this is what they would find:

Salt Vinegar	+	Water	+	Carbon Dioxide
$\text{NaC}_2\text{H}_3\text{O}_2$	+	H_2O	+	CO_2
9. Weigh the balloon with the gas still in it and the bottle with the liquid and solid in it. Does it weigh the same as it did before the combination? YES!

10. The reason it weighs the same is because none of the atom particles were lost and none were added. Have them notice that while they were broken apart they looked like this: H C C H H H O O Na H C O O O. Then they grouped together and made new substances. These above atom particles now have new partners and no atom particles were lost.
11. Take the balloon off the bottle and let the gas out. Now put the balloon back on the scale. Does it weigh the same now? (No.) Why? (Because carbon dioxide has weight and it weighs less now that the gas is not part of the weight.)
12. Review: Why is it a chemical change?

It is a chemical change because:

- a. Three new substances are formed:
 - i. salt-vinegar—a solid at the bottom of the flask
 - ii. water—the clear liquid
 - iii. carbon dioxide—the gas in the balloon
 - b. Temperature change
 - i. The bottom of the flask is cold
 - c. There was combustion (fizzing).
13. Have the students write their conclusions of what they learned from the experiment.