There's No Going Back! - Non-reversible Changes

Grade level: 5

Strand: Matter and Materials

Topic: Properties of and Changes in Matter

Specific Expectations:
- Identify and describe some changes to materials that are reversible and some that are not (a non-reversible change)
- Describe examples of interactions between materials that result in the production of a gas.
- Identify the three different states of matter – solid (ex. candle, bowl, sticky tack, and baking soda), liquid (ex. vinegar) and gas (ex. carbon dioxide) – and give examples of each state.

Required Materials:
- Baking soda
- Beaker or Heatproof bowl
- A short candle
- Vinegar
- Modelling clay or sticky tack
- A spoon or scoop

Procedure:
1. Attach the candle firmly to the bottom of the bowl, using the modelling clay or sticky tack.
2. Sprinkle 5 even spoonfuls of the baking soda around the base of the candle.
3. Light the candle.
4. Spoon vinegar down the side of the bowl, being careful to avoid the lit candle (the vinegar and baking soda should now begin to froth)
5. Stop adding the vinegar when the baking soda/vinegar froth reaches halfway up the side of the candle. The candle should go out.
6. Try to relight the candle.

Definitions:

Solid - a state of matter that has definite shape and volume. Its shape is not dependent on its container.

Liquid - a state of matter that flows and has a fixed volume. It takes the shape of its container.

Gas - a state of matter that takes the shape and volume of its container.
Reversible change - a change of state of matter that can be changed back to its original state. For example liquid water can be frozen to solid ice and melted to liquid water again.

Non-reversible change - when matter experiences a change of state that is not reversible, the matter cannot be returned to its original state. For example, when boiling an egg, the liquid inside of the egg becomes solid and cannot be made liquid again.

Scientific Principles

When the baking soda and vinegar are combined they react. This results in a non-reversible change and the production of carbon dioxide gas. The production of this gas is demonstrated by the frothing that occurs when the baking soda and vinegar are combined. The fact that the candle goes out demonstrates that this gas is carbon dioxide. The carbon dioxide that is produced surrounds the candle and puts out the flame. The flame no longer has access to the oxygen it needs to stay lit, because the carbon dioxide has replaced the oxygen in the bowl. The carbon dioxide is heavier than the oxygen, so the oxygen rises up and the carbon dioxide fills the bowl, extinguishing the candle in the process. This change is non-reversible since the properties of both the baking soda and vinegar have been altered in such a way that they cannot be brought back from the new products that were formed.

Other Considerations:

Safety! This is not an experiment for students to do by themselves; an adult should light the candle as well as pour the vinegar inside the bowl, being careful to avoid the flame.

Crushed Alka-Seltzer tablets could be used instead of the baking soda if water is used instead of vinegar; this reaction will also produce carbon dioxide gas and is non-reversible.

The experiment works best if you use a short candle, a small bowl with high sides, keep the baking soda close to the candle and put it lots of baking soda at least 5 spoonfuls.

Some fire extinguishers use carbon dioxide, since it displaces oxygen and prevents continued burning.

Appropriate references:


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