W1334

FIZZY LEMONADE

Understanding the Science Behind It

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Fizzy Lemonade

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Skill Level
Beginner (4th - 5th graders)

Learner Outcomes
The learner will be able to:

- Understand the reaction between acids and bases
- Understand the effect of carbonation on food drinks

Educational Standard(s) Supported
CHEM1.PS1, CHEM2.PS1

Success Indicator
Learners will be successful if they:

- Can produce the fizzy lemonade and understand the science behind it

Tags
4-H STEM
Food Science

Time Needed
30 minutes

Materials List
- Cold water
- 2 lemons
- 1 teaspoon of baking soda
- 1 teaspoon of sugar
- A plastic or glass cup
- A stirring spoon
- A knife for slicing lemons
- A lemon juicer/press (recommended)
- Ice (optional)
- Food Science Fizzy Lemonade Guide

Note: The recipe can be easily scaled up as needed.

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Introduction to Content

How does mixing flour, sugar, cocoa powder, baking soda, butter, milk, and eggs make a delicious, fluffy chocolate cake? Food chemistry helps us understand the science behind why and how food ingredients interact with each other. By studying food chemistry, we can control texture, flavor, color and even the way food behaves during preparation. For example, when we mix baking soda with lemon juice, it creates a fun reaction that produces bubbles, which makes the lemonade fizzy.

Thanks to these interactions, not only do we make food taste better, but we can also experiment with new flavors, colors, textures and techniques. By learning about food chemistry, we can turn basic ingredients into extraordinary and enjoyable foods.

Introduction to Methodology

This activity utilizes group discussions to help students understand the science behind fizzy lemonade. It also aims to have students work together, or in pairs, to create fizzy lemonade.

Terms and Vocabulary

Acid: An acid is a substance that can release hydrogen ions when dissolved in water. This makes it taste sour (like lemon juice or vinegar). Acids can react with other substances and typically undergo a chemical reaction that changes in the properties of both acid and the other substances.

Baking Soda: Baking soda, also known as sodium bicarbonate, is a white powder used in cooking, especially baking. It is a base that reacts with acids, causing a chemical reaction that helps baked goods rise. It is also used for cleaning because it can help break down grime.

Base: You can think of a base as the opposite of an acid. It is a substance that can accept hydrogen ions and usually feels slippery or soapy. Baking soda is a good example for a base found in your kitchen. Bases can neutralize acids, balancing out their effects.

Carbonation: Carbonation refers to the process of dissolving carbon dioxide gas in a liquid, which creates bubbles when the gas escapes. It is what makes sodas, sparkling water and other fizzy drinks bubbly. Gas is what gives drinks their fizz.

Chemical Reaction: A chemical reaction happens when two or more substances interact and form a new substance. This can involve changes in color, temperature, gas production or even the formation of a solid from liquids.

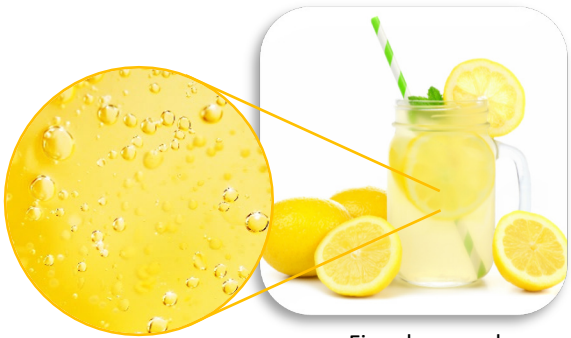
Citric Acid: Citric acid is an acid found in citrus fruits like lemons, limes and oranges. It gives these fruits their sour taste and is often used in foods and drinks as a preservative or flavor enhancer.

Carbon Dioxide (CO_2): Carbon dioxide is a colorless, odorless gas made of one carbon atom and two oxygen atoms. One way to make CO_2 is by mixing baking soda with an acid. In lemonade, this reaction creates bubbles and makes it fizzy.

Baking soda
(base)


Lemon juice
(acid)


Carbon dioxide
gas (CO_2)


Fizzy lemonade

Opening Question/Setting the Stage

Ask, "Why is soda fizzy? And where do the bubbles come from?" **ANSWER - Carbonation! Carbonation is the process of dissolving carbon dioxide (CO_2) gas into a liquid. In this activity, we are going to create and observe a chemical reaction between an acid (lemon juice) and a base (baking soda). This reaction produces carbon dioxide gas, which forms bubbles and gives the drink its fizz!**

Say, "This is the same process that happens in all fizzy drinks. When CO_2 is added under high pressure and kept cold, it easily dissolves into the liquid. But as soon as you open a bottle or can, the pressure is released, and the gas bubbles rise to the surface, escaping as that familiar fizz."

Strategies to Increase Student Engagement

- Have the students share their favorite fizzy drink.
- Ask if anyone has made a fizzy lemonade.
- Make sure every student has an opportunity to participate.

Launch the YouTube video on carbonation. The video is less than two minutes long. youtube.com/watch?v=MAGVban77BQ

Ask, "What is something you learned from the video?" Let students answer and give them affirmation for their answers.

Say, "Let's get started and make fizzy lemonade by creating a chemical reaction between baking soda and lemon juice!"

Experience

Divide students into groups of two to three. Use the "Food Science Fizzy Lemonade Guide" to help students complete the experiment described below. Have them follow the steps below:

1. Squeeze the juice from each lemon into a glass, ensuring you get every drop.
2. Pour in an equal amount of cold water into the lemon juice and give it a quick taste.

   Ask, "How does it taste? Is it sweet? Is it sour?"
3. Sweeten it by stirring a teaspoon sugar in, then take another sip.

   Ask "How does it taste now?" Is it sweet enough? Is it still sour?
4. Add a teaspoon of baking soda and stir it in.

   Ask, "What do you notice? Did the taste change?
5. The magic is in the fizz! Try changing the amount of baking soda until you find the perfect level of bubbles for your taste.
6. Congratulations! You just created a chemical reaction! To make it extra refreshing, throw in some ice cubes. Now enjoy your fizzy lemonade!

Share
Say: “Share something you learned from this experiment with the person next to you.”

Process
Guide students through a discussion to help them understand how chemical reactions can be used to create new food products. Start by asking them to think about how different ingredients come together to form something new.

Encourage students to think about other examples, like how fermentation turns cucumbers into pickles. Help them see that food chemistry is more than just mixing ingredients; food chemistry is also about how ingredients react and interact to form entirely new food products.

Explain that reactions between ingredients, like acids, bases or heat, can change the texture, taste and appearance of food. Reactions can result in something completely different from the original ingredients, (such as turning flour, water, and salt into bread or transforming milk into cheese).

Notes

Generalize
Share the following information with the students:

Say, “Making lemonade fizzy and cake rising involves a similar chemical reaction, where carbon dioxide gas plays a key role in both processes.”

1. Fizzy Lemonade: When you mix lemon juice with baking soda, the acid in the lemon juice reacts with the base in the baking soda. This reaction produces carbon dioxide gas, which forms bubbles. These bubbles are what make the lemonade fizzy and give it that bubbly texture.

2. Cake Rising: When you make cake batter, ingredients like baking soda or baking powder (which contains dry acid and base components) react with other ingredients, often in the presence of moisture or heat. This reaction also produces carbon dioxide gas. The gas forms bubbles that get trapped in the batter, causing it to expand and rise, which makes the cake light and fluffy.

In both cases, the release of carbon dioxide gas creates bubbles. In fizzy lemonade, the bubbles stay in the liquid, making it fizzy. In a cake, the bubbles expand inside the batter, causing it to rise and become airy. Both processes rely on a chemical reaction that produces gas, but they lead to different results. Bubbles in a drink versus a risen, fluffy cake!

Apply

Ask, “Now that you've learned how a chemical reaction can produce carbon dioxide gas to create bubbles, identify other food products where a similar reaction occurs.”

Supplemental Information

Educational Standards Met

CHEM1.PS1: Matter and Its Interactions
4) Use the reactants in a chemical reaction to predict the products and identify reaction classes (synthesis, decomposition, combustion, single replacement, double replacement).

CHEM2.PS1: Matter and Its Interactions
15) Explain common chemical reactions, including those found in biological systems, using qualitative and quantitative information.

TIPPS

Life Skills

- Head – Managing, Thinking
- Health – Living, Being

References

Arnett M. (n.d.). *Make Your Own Fizzy Lemonade*. Science Buddies. Received from: sciencebuddies.org/stem-activities/make-your-own-fizzy-lemonade

Name: _____ Date: _____

Fizzy Lemonade Experiment Worksheet

Question:

Hypothesis:

Materials:

Procedures:

Results:

Conclusion:

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