



# Chemical Reactions

## Overview

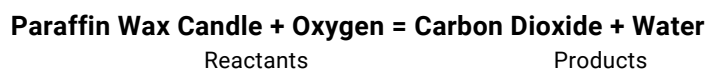
This engaging module introduces and explores the concept of **chemical reactions** – creating a new substance from two or more other substances. Let's dive into some chemical fun that provides insight into the invisible world of chemistry that surrounds us.

## Background

**Chemical reactions** are fascinating processes that occur all around us, driving essential activities such as burning fuel, digesting food, and creating new materials. These transformations happen when substances interact, resulting in the production of new substances with different properties.

To identify whether a chemical reaction is taking place, we can look for key indicators. Changes in color, the presence of bubbles, temperature variations, and even the emission of light or sound are clues that signal a reaction is occurring. One common feature of chemical reactions is a change in temperature, which indicates energy transfer. Reactions that release energy as heat are called **exothermic**, while reactions that absorb energy from their surroundings are **endothermic** (requiring energy). These changes occur because of the breaking and forming of chemical bonds, which rearranges atoms to form new substances.

A classic example of a chemical reaction is mixing **baking soda** with **vinegar**. This reaction produces **carbon dioxide** (CO<sub>2</sub>), water (H<sub>2</sub>O), and sodium acetate (CH<sub>3</sub>COONa). Another everyday example is lighting a candle. In this case, the wax, which is a hydrocarbon, reacts with oxygen in the air during combustion.



Using a databot™, it's possible to monitor and visualize the chemical changes occurring during these reactions.



**Grades:** Middle School

**Time:** 45 Minutes

**Subject:** Physical Science

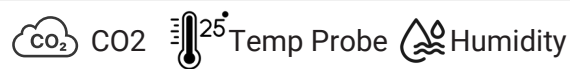
**Topics:** CO<sub>2</sub>, Chemical reaction, Endothermic & Exothermic reactions, Temperature, Humidity.

## What You Will Need/Prep

- databot + temperature probe
- IOS/Android Smart Device 
- Airtight container and glasswares
- Baking soda and vinegar
- Candle, matches or a lighter
- Install Vizeey™ on your Smart device. 
- Scan the QR code to load the experiment.



- Test your databot™ connection.
- You will be prompted to select and connect to databot™ each time you launch an experiment.
- If there are two or more databot™'s listed, the one closest to your device will be highlighted.
- Study the background information and terms and prepare to explore!



This lab activity helps to observe and measure chemical reactions under controlled conditions using a sealed container and databot™. The activity will be conducted in two parts: the reaction between baking soda and vinegar and the combustion of a candle.



### Learning Objectives

In this exploration you learn, understand & recognize the following knowledge and skills:

- Visualize, collect and analyze data
- Measure and record CO<sub>2</sub> level, temperature and humidity
- Understand Chemical Reactions
- Identify Signs of Chemical Reactions
- Explore energy changes in chemical reactions
- Type of reaction and changes that happen when **vinegar** is added to the **baking soda**.
- Analyze Combustion as a Chemical Reaction

### Important Terms

**Baking Soda:** Sodium bicarbonate (NaHCO<sub>3</sub>), is an alkaline salt and is one of the reactants in the vinegar–baking soda reaction.

**Carbon Dioxide (CO<sub>2</sub>):** A colorless, odorless gas naturally present in the air you breathe and is absorbed by plants in photosynthesis. CO<sub>2</sub> is one of the products of the vinegar-baking soda reaction comprised of 1 carbon atom and 2 oxygen atoms.

**Chemical Reaction:** This occurs when substances combine to produce one or more new substances.

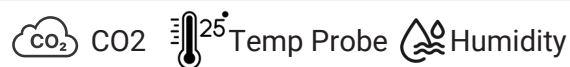
**Endothermic Reaction:** A type of chemical reaction that requires energy to take place. When this happens you will see a drop in temperature in your reactants.

**Exothermic Reaction:** A type of chemical reaction that produces energy. When this happens you will see an increase in temperature.

**Humidity(RH):** The percentage of water vapor in the air you breathe. You will notice humidity changes when you travel – for example, in the desert there is very low humidity and by the sea, you will have high levels of humidity.

**Parts per million - (ppm):** Usually describes the concentration of something in air, water or soil. The term ppm expresses the number of units (part) of a given substance that exists as a portion of a greater substance comprised of one million parts.

**Vinegar:** A mixture of acetic acid (CH<sub>3</sub>COOH) and water (H<sub>2</sub>O) that is one of the reactants in the baking soda - vinegar reaction.



### How to work with Vizeey app.

In order to work with the experiment you need to launch Vizeey application and click on + in the upper right corner.


Then select “Add experiment from QR code” and scan the QR code prepared for this experiment. Your experiment will appear in the list.

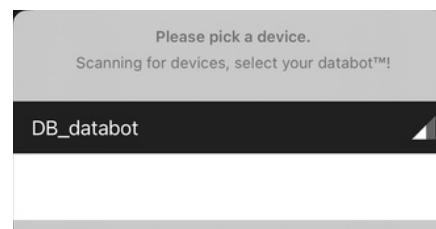
When you start the experiment you will be immediately offered to connect to your databot. Make sure that your databot is turned on and the blue light is blinking.

Don't forget to check that the temperature probe is connected to the Temp 1 port.

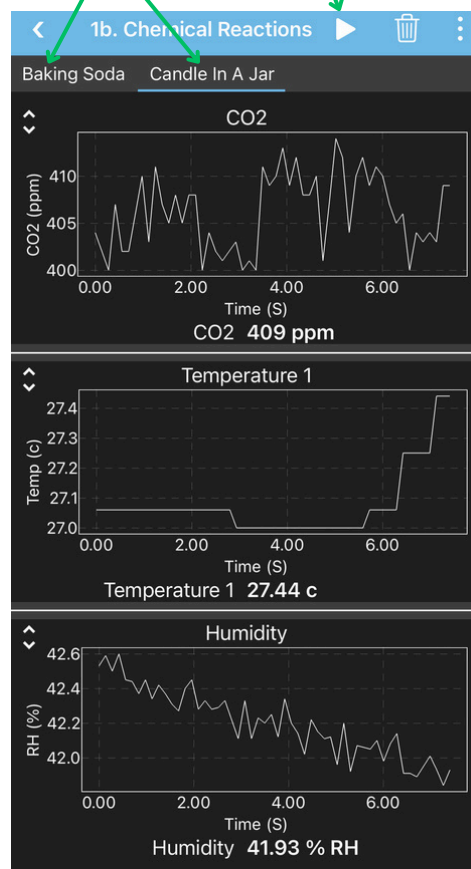
You are going to use the temperature probe, CO2 and humidity sensors in this exploration. Let's test to make sure everything is working properly!

- Measure your body temperature by holding the temperature probe tightly in the palm of your hand.
  - The temperature is measured in °C (Celsius).
- Bring your databot closer to your mouth and breathe on databot, you will see the CO2 levels elevate as you exhale CO2.
  - The CO2 is measured in **ppm (parts per million)**.
- When you exhale, the humidity will also change - we exhale water vapor also!
  - Relative Humidity is is measured in %; it compares the amount of water vapor in the air to the maximum amount the air can hold at a specific temperature.

Now that you have a good grasp of measurement, clear your data using:  and proceed to the experiment.



Press this button to start the experiment.  
Choose your experiment here



### Part 1: Initial Observations and Questions

#### **Baking Soda and Vinegar Reaction**

What do you think will happen when baking soda and vinegar are mixed in a sealed container? Will you be able to observe the new substance formed during the reaction? Write your thoughts or questions below.

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#### **Burning Candle**

What changes do you expect to observe when a candle burns in a sealed container? Write your predictions or questions below.

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### Part 2: Hypothesis

#### **Baking Soda and Vinegar Reaction**

Temperature Hypothesis:

Do you think there will be any change in temperature in mixture Baking Soda and Vinegar? Predict the temperature will increase, decrease, or stay the same?

Prediction: \_\_\_\_\_  
\_\_\_\_\_

#### **Burning Candle**

Predict how the temperature, humidity, and CO<sub>2</sub> levels will change when a candle burns in a sealed container? Write your predictions or questions below.

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### Part 3: Experiment Procedure

#### Baking Soda and Vinegar Reaction

Before starting the experiment, prepare the necessary materials.

You will need:





- databot with an attached temperature probe;
- a sealed, airtight container;
- a container like a beaker for the reaction to take place in;
- baking soda and vinegar.



Set up your "experiment chamber": an airtight container that will capture the CO<sub>2</sub> gas produced by the reaction.

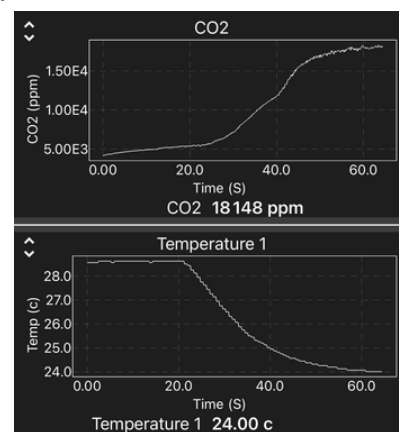
Place databot into the container, then place the temperature probe flat on the bottom of your reactant glassware so it will be covered by the reaction.



- Turn on databot (using the small button on the left side). Open the Vizeey app on your smart device. 
- Tap on "**Chemical Reactions**" in Vizeey to load the experiment.
- You will be prompted to connect to databot.
  - Hint- if there is more than one databot in use, the one closest to you will be in blue!
  - A solid blue light on databot means you are connected.
- Choose the tab "*Baking Soda*" and start your experiment using: 
- Use these icons   at the top of the screen in Vizeey to start and to pause the experiment.
- Begin recording and note down the initial temperature and CO<sub>2</sub> reading in the table.
- Measure 5 ml (1 tsp) of Baking Soda into your reactant glassware located in your chamber.
- Add 10 ml (2 tsp) of vinegar (acetic acid) to your reactant glassware. Seal the chamber and watch the data as the reaction takes place! Run the experiment for 60 seconds.

#### Data Collection Table

Experiment Variable	Starting Reading	End Reading	Net Change +/-
Temperature (C)			
CO <sub>2</sub> (PPM)			



Part 3: Experiment Procedure

**Burning Candle**

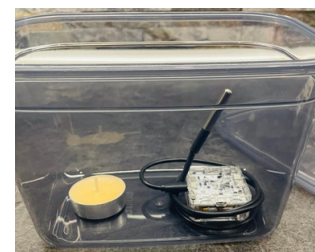
Before starting the experiment, prepare the necessary materials. You will need:

- databot with temperature probe;
- a sealed container;
- candle;
- matches or a lighter.





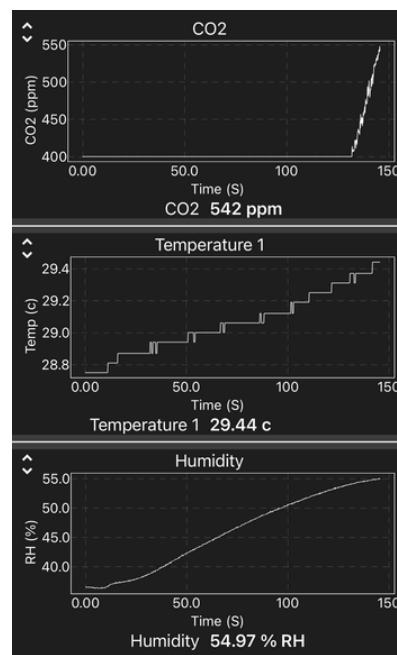
Preparation

- Connect the temperature probe on databot Port 1.
- Prepare the testing chamber with your databot and temperature probe on one side of the chamber and the candle on the opposite side.
  - Don't forget to turn on your databot in the chamber.
  - Make sure the temperature probe is kept elevated and won't fall into the flame.
- Practice putting the top on your container and sealing it so you can do it smoothly when you begin your experiment.



*Important! Have supervision and permission for lighting candles and working with fire!*

- Open the Vizeey app and turn on databot.
- Tap on "**Chemical Reactions**" in Vizeey and choose the second part of experiment.
- Choose the tab "Candle in a Jar" and start your experiment using: 
- Write down the starting levels for CO2, Temperature, and Humidity (RH).
- Light the candle and quickly seal the chamber. Watch the data as the candle burns.
  - The candle will use up some of the oxygen in the chamber and go out after a minute or two.
- Stop the recording when the candle goes out using  . Write down the end levels from your data recording.
- Calculate the net change for CO2, Temperature, and **Humidity**.



**Data Collection Table**

Experiment Variable	Starting Reading	End Reading	Net Change +/-
Temperature (C)			
CO2 (PPM)			
Humidity (RH)			

Part 4: Data Analysis and Concept Questions**Baking Soda and Vinegar Reaction**

Data Interpretation:

1. What did you observe happening in the container?

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2. How did CO<sub>2</sub> levels and temperature change over time?

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3. What evidence supports that a chemical reaction occurred?

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**Burning Candle**

Data Interpretation:

1. What happened to the flame in the sealed container?

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2. How did CO<sub>2</sub> levels, temperature, and humidity change over time?

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3. How does this demonstrate combustion as a chemical reaction?

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Part 5: Reflection

1. What signs of a chemical reaction did you observe in each experiment?

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2. How did databot™ data help you understand what was happening in the sealed container?

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3. How do these experiments connect to real-life examples, like car engines or breathing?

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4. What questions or ideas do you have after completing this lab? Write them below.

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