

# Fermentation of Yeast

## Overview

Have you ever wondered how bread rises or how tiny organisms create bubbles in dough? Today, you will learn about a microorganism called yeast and explore how different amounts of sugar affect its activity. By feeding yeast various sugar quantities, you will measure the amount of carbon dioxide (CO<sub>2</sub>) it produces.

## Background

Fermentation is a biological process carried out by microorganisms such as yeast and bacteria. During fermentation, yeast breaks down sugar molecules to release energy. In this process, carbon dioxide (CO<sub>2</sub>) and alcohol are produced as byproducts.

Yeast is a single-celled organism belonging to the Fungi kingdom. When yeast is dry or cold, it remains inactive (dormant). However, when placed in warm water, it becomes active and begins feeding on sugar. Warm temperature activates enzymes inside yeast cells. Enzymes are special proteins that speed up chemical reactions necessary for life.

Yeast produces energy through a process called anaerobic respiration. “Anaerobic” means “without oxygen.” Unlike humans, who primarily use oxygen to release energy from food (aerobic respiration), yeast can produce energy without oxygen when it is in a sealed environment. In anaerobic respiration, yeast breaks down sugar and releases:

- Carbon dioxide (CO<sub>2</sub>)
- Alcohol (ethanol)
- Energy for the yeast cell

The more active the yeast, the more CO<sub>2</sub> it produces – but is more sugar always better?

**Grades:** Middle School

**Time:** 45 Minutes

**Subject:** Life Science

**Topics:** Fermentation, Microorganisms, CO<sub>2</sub> Production, Data Collection and Analysis

## What You Will Need/Prep

- databot
- IOS/Android Smart Device 
- Warm water (110°F / 43°C)
- Active dry yeast, sugar
- Small bowl and spoon
- Airtight container
- 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!

Too little sugar may limit fermentation because the yeast does not have enough food. However, too much sugar can slow the process because high sugar concentrations can draw water out of yeast cells, reducing their activity. This means there is an optimal balance where fermentation works most efficiently.

At the end of this lesson, you will determine the optimal sugar-to-yeast ratio that results in the highest CO<sub>2</sub> production. Using databot™, you will observe fermentation in real time and collect scientific data to support your findings.



### Learning Objectives

In this investigation you will master the following knowledge and skills:

- Visualize, collect and analyze data
- Measure and record CO<sub>2</sub> levels in ppm.
- Understand fermentation as a biological process.
- Identify how sugar concentration affects yeast activity.
- Practice controlled experimental design.
- Use data to determine an optimal biological ratio.

### Important Terms

**Carbon Dioxide (CO<sub>2</sub>):** A gas produced during fermentation.

**Fermentation:** The chemical breakdown of sugar by microorganisms, producing CO<sub>2</sub> and alcohol.

**Microorganism:** A microscopic living organism.

**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.

**Plateau:** The point where CO<sub>2</sub> levels stop increasing significantly.

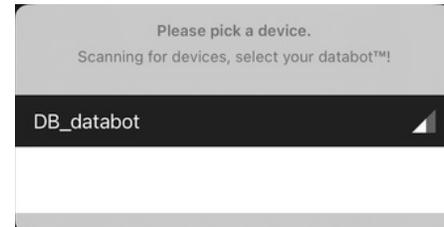
**Yeast:** A single-celled microorganism belonging to the fungi kingdom.

Using Vizeey

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

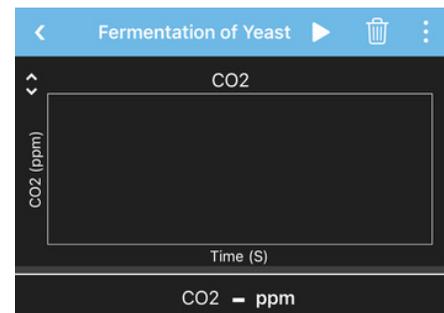
Then select “Add experiment from QR code” and scan the QR code prepared for this experiment. Your experiment will appear in the list.

When you start the experiment you will be immediately offered to connect to your databot. Make sure that databot is enabled.



You are going to use the CO2 sensor in this exploration. Let’s test to make sure everything is working properly!

- 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).



Now clear your data using  and proceed to the experiment.

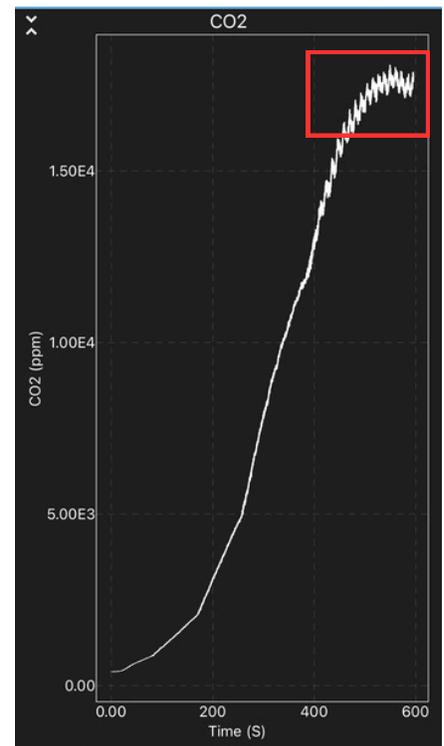
How to Recognize a Plateau on the Graph

As you observe the CO<sub>2</sub> graph in "The Yeast Beast" Vizeey experiment, you will see the line begin to rise as yeast produces carbon dioxide.

A plateau occurs when:

- The graph line stops rising quickly.
- The curve begins to level off.
- The CO<sub>2</sub> values increase very slowly or remain nearly constant.
- The graph looks almost flat for several seconds.

When you notice the graph leveling off and staying nearly flat, that is your signal to stop the experiment and record the highest CO<sub>2</sub> value displayed.



Part 1: Initial Observations and Questions

What do you think will happen when yeast is mixed with warm water and sugar inside a sealed container? Write your thoughts below.

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Do you think more sugar will always produce more CO<sub>2</sub>?

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Part 2: Hypothesis

Predict how CO<sub>2</sub> levels will change as the amount of sugar increases.

- Will CO<sub>2</sub> production increase continuously?
- Is there a maximum point?
- Can yeast be “overfed”?

Write your prediction below.

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Part 3: Experiment Procedure

Before starting the experiment, prepare the necessary materials.

You will need:

- databot;
- a sealed, airtight container large enough to hold bowl + databot;
- Small bowl for the reaction to take place in;
- Spoons to measure yeast and sugar
- Warm water (110°F / 43°C) - ½ cup per trial;
- Active dry yeast (1 teaspoon per trial);
- Sugar (½ tsp, 1 tsp, 1.5 tsp, etc.)



Part 3: Experiment Procedure

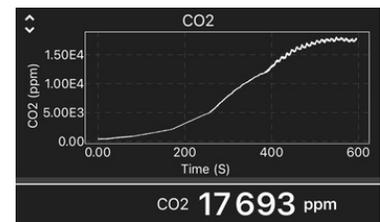
- Activate the Yeast:
  - Pour ½ cup warm water (110°F / 43°C) into a bowl.
  - Add 1 teaspoon of yeast.
  - Stir gently until fully dissolved.
- Feed the Yeast:
  - Add ½ teaspoon of sugar.
  - Stir until dissolved.
- Set Up the Chamber:
  - Place the open bowl inside the airtight container.
  - Place databot™ inside the same container.
  - Seal the container tightly to prevent ventilation.



Seal the container to avoid ventilation that may interfere with your data!

1/2 cup of warm water + yeast + sugar and databot™ inside a container

- Open the Vizeey app on your smart device. 
- Turn on databot (using the small button on the left side)
- Tap on "The Yeast Beast" in Vizeey to load the experiment.
- Start your experiment using:  and watch the data!



- As fermentation occurs, CO<sub>2</sub> levels will begin to rise. Continue observing until the graph reaches a plateau – this means the CO<sub>2</sub> level stops increasing significantly and begins to level off.
- As soon as the graph reaches a plateau, stop the experiment using .
- Once you reach a plateau, note the highest CO<sub>2</sub> level and time for the tested amount of sugar in the table below.
- Repeat the experiment with increased sugar:
  - Clear the previous data set in Vizeey™.
  - Prepare a new yeast mixture using the same amount of water and yeast.
  - Increase the sugar amount (for example: 1 teaspoon, then 1.5 teaspoons).
  - Repeat the experiment following the same procedure.
  - Stop each trial when the graph reaches a plateau and record the maximum CO<sub>2</sub> value.

*Note: Make sure all other variables remain constant (water temperature, yeast amount, container size) so that sugar amount is the only changing variable.*

### Part 3: Experiment Procedure

#### Data Collection Tables

You will record the maximum CO<sub>2</sub> value at the plateau for each sugar amount tested.

#### Data Collection Table

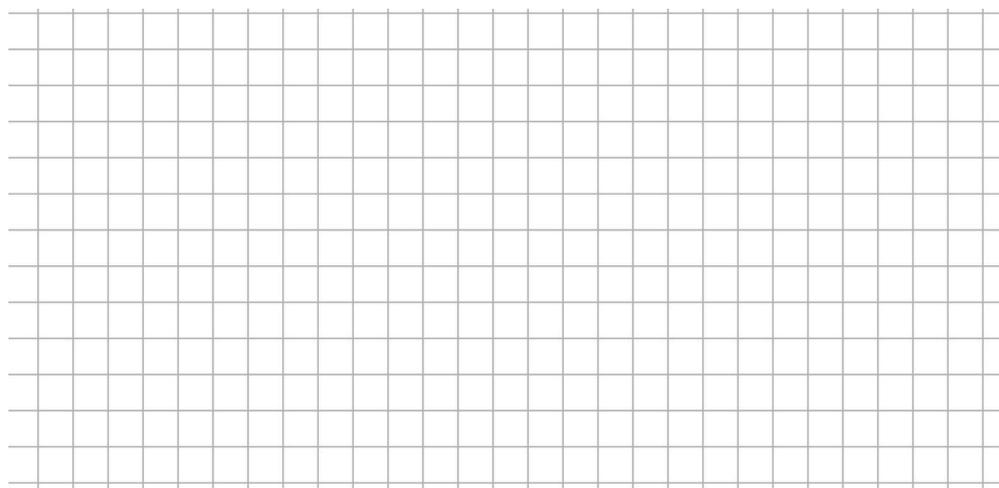
Sugar Amount (tsp)	Maximum CO <sub>2</sub> (ppm)	Time to Plateau (s)	Observations
0.5			
1.0			
1.5			
2.0 (optional)			

### Part 4: Data Analysis

Now that you have collected your data, it is time to analyze your results and determine the optimal sugar-to-yeast ratio.

- Identify which sugar amount produced the highest CO<sub>2</sub> value. \_\_\_\_\_

- Compare the time it took to reach the plateau in each trial.
- Create a bar graph to visually compare your results.
  - X-axis: Sugar Amount (tsp)
  - Y-axis: Maximum CO<sub>2</sub> (ppm)



Part 4: Data Analysis

- What pattern do you notice between sugar amount and time to plateau?

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Answer the question. Support your conclusion using evidence from your data.

- What is the best sugar-to-yeast ratio for maximum CO<sub>2</sub> production?

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- Did you observe signs of “overfeeding” the yeast?

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Part 5: Concept Questions

1. What gas is produced during fermentation? \_\_\_\_\_

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2. Why must the container be sealed?

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3. Why does yeast need warm water to activate?

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4. Why might too much sugar reduce yeast activity?

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5. What evidence shows that fermentation occurred?

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Part 6: Reflection

1. What did you learn about how microorganisms produce energy?

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2. How did data help you determine the best sugar ratio?

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3. If you were designing a commercial bakery, how would this information help you?

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