

# The Cave of Dogs!

Overview - A CO<sub>2</sub> Science Mystery

Grades: 5-8

Time: 50 minutes (PDQ's + Experiment)  
50 Minutes (Challenge + Collaboration)

Subject: Chemistry

Topics: Properties of Gasses, [Chemical Reactions](#)



## Overview

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Get ready to stir up some fizzy, bubbly [chemical reactions](#) while you explore properties of gases that create some thought provoking real-world phenomena!

## Background

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What on earth is this crazy Cave of Dogs mystery all about? Imagine a mysterious cave that affects people and animals quite differently as they enter it and explore. Such a place actually exists, it is called the “Grotta del Cane” or the Cave of Dogs and it is located near Naples, Italy. The “mystery” of the cave is how it affects different animals that enter the cave. A human can enter and walk about with no problem, but dogs and other small animals that enter might pass out or even die.

The answer to the mystery? If you haven't already guessed, the more [dense Carbon Dioxide \(CO<sub>2</sub>\)](#) gas settles into the lower areas of the cave and animals that are close to the ground could asphyxiate if they stay in the cave too long. Humans, walking upright, are above the [CO<sub>2</sub>](#) level and able to breathe in the life-giving oxygen that [CO<sub>2</sub>](#) displaces at a lower level. This mysterious cave in Italy has a [fumarole](#) from which volcanic gases including [CO<sub>2</sub>](#) seep into the cave making it a very dangerous place to be if you want to be able to breathe!

*Let's explore further with databot™!*

## What You'll Need

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- Android smart device with Bluetooth Low Energy (BLE) to connect to databot™
- databot™ + Phypox App installed on your Android device
- 2 Liter Plastic Bottle
- 12” round balloons (3 or more to be safe)

## What You'll Need (continued)

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- Vase or Jar (Your Cave of Dogs)
- Tea Candles - 3
- Lighter (Long-Handled)
- Yardstick + Cloth Measuring Tape
- Binder Clips - 3
- Paper Clips - 5
- Pencil or Dowel + a Heavy Book / **weight**.
- Funnels - to control your pours!
- Blocks – LEGO works well.
- Baking Soda
- White Vinegar

## Important Terms

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**Carbon Dioxide (CO<sub>2</sub>):** A colorless, odorless gas naturally present in the air you breathe and is absorbed by plants in photosynthesis. There would be no animal life or green plants without **carbon dioxide**. Green plants use energy from the sun plus **carbon dioxide** and water to produce carbohydrates and oxygen.

**Weight:** A measurement of the force of gravity applied to an object – it is calculated by multiplying an object's mass by the acceleration of gravity. The **weight** of an object can vary depending on the gravitational field it is in.

**Volume:** The amount of space a substance takes up.

**Density:** An object's mass in a given **volume**. For example, a 1 cm cube of gold is much more **dense** than a 1 cm cube of balsa wood so the **weight** of the gold cube is much, much heavier.

**Chemical Reaction:** A reaction that occurs when substances combine to produce one or more new substances.

**Reactant:** The starting substance that enters into a **chemical reaction**.

**Product:** The substance created in a **chemical reaction**.

**Fumarole:** An opening in the Earth's crust through which volcanic fumes are emitted.

**Prep (5 mins)** \_\_\_\_\_

- Scan the QR Code on page 1 with your Phyphox sensor app to load the CO<sub>2</sub> sensor settings for all activities in the CO<sub>2</sub> Science Series.
- Read the background information, study the terms, and explore the additional resource links.

**Ready to get started? Let's go!**

Next stop – PDQ1 – that means Pretty Darn Quick.

## Educator Resources

*This science mystery is all about Carbon Dioxide (CO<sub>2</sub>), an important gas that is an integral part of our ecosystem. Plants eat it, we exhale it, and too much of it can be harmful!! In this module the activities explore a specific property of gases – gases have “weight.” CO<sub>2</sub> is heavier than air which is illustrated in PDQ 2 as students actually see air being weighed against CO<sub>2</sub>. The first PDQ is the always popular baking soda and vinegar reaction, but it is done with a simple apparatus that enables students to capture and store CO<sub>2</sub> in a balloon. The actual Cave of Dogs experiment is a dramatic demonstration of CO<sub>2</sub> putting out candles as CO<sub>2</sub> is released from the balloon and slowly fills a simulated “Cave of Dogs” extinguishing candles placed at different heights.*

### Prep

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- Read the background information, study the terms, and explore the additional resource links.
- Do the PDQ’s and Experiment and review the accompanying educator information.
- Review the Challenge and Collaboration extensions if of interest.
- Scan the QR Code on page 1 with your Phyphox sensor app to load the CO<sub>2</sub> sensor settings for all activities in the CO<sub>2</sub> Science Series.

### Objectives

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Understand & Recognize:

- A **chemical reaction** is when two substances react with one another to create a new, different substance.
- **Chemical reactions** can cause physical and chemical changes in substances – even creating gas where there was none before.
- Gases have **weight**, and different gases are heavier or lighter than others.
- A **fumarole** is a volcanic vent, an opening in the earth’s crust, that emits steam and gases.

## Objectives (continued)

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- CO<sub>2</sub>:
  - An invisible and odorless gas.
  - Is deadly to animals in concentrated amounts.
  - Heavier than air
  - Exhaled by humans
  - It can be generated through a **chemical reaction** of baking soda and vinegar.
  - Levels can vary in the air around us depending on many factors.

## NGSS

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- 5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen.
- 5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
- MS-PS1-2: Analyze and interpret data on the properties of substances before and after the substances interact to determine if a **chemical reaction** has occurred.
- NGSS Practice 4: Analyzing and Interpreting Data  
*Excerpt: When possible and feasible, students should use digital tools to analyze and interpret data. Whether analyzing data for the purpose of science or engineering, it is important students present data as evidence to support their conclusion.*

## Misconceptions

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- Air has no **weight**.

## Guiding Questions

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- Why do the candles go out from the bottom up?
- Why do you suppose the cave is more dangerous to animals than people?

## Additional Resources

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The Grotta Del Cane (Dog Cave), Naples, Italy

Article, W.R. Halliday; Arrigo Cigna. January 2006

[https://www.researchgate.net/publication/290890558\\_The\\_Grotta\\_Del\\_Cane\\_Dog\\_Cave\\_Naples\\_Italy](https://www.researchgate.net/publication/290890558_The_Grotta_Del_Cane_Dog_Cave_Naples_Italy)

Cave of Dogs

Illinois Library, Rare Book and Manuscript Library

<https://www.library.illinois.edu/rbx/2016/12/15/cave-of-the-dogs/>

Atmospheric Pressure, the [weight](#) of air

WW2010, University of Illinois

[http://ww2010.atmos.uiuc.edu/\(Gh\)/guides/mtr/prs/def.rxml](http://ww2010.atmos.uiuc.edu/(Gh)/guides/mtr/prs/def.rxml)

Carbon Dioxide

Wikipedia

[https://en.wikipedia.org/wiki/Carbon\\_dioxide](https://en.wikipedia.org/wiki/Carbon_dioxide)

Balancing Balloons, Air Has [Weight](#)

Fun Science Demos with Jared, Youtube Video

[https://www.youtube.com/watch?v=o5LT\\_wfI98w](https://www.youtube.com/watch?v=o5LT_wfI98w)Cave of Dogs

NASA, Does Air Have [Weight](#)? How Do You Know?

A Structured-Inquiry Activity

[https://www.nasa.gov/centers/langley/pdf/245898main\\_MeteorologyTeacherRes-Ch7.r3.pdf](https://www.nasa.gov/centers/langley/pdf/245898main_MeteorologyTeacherRes-Ch7.r3.pdf)

## References:

[Fumarole](#) Image by [Monika P](#) on Pixabay!

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