

The Cave of Dogs!

PDQ 2 - Weighty Thoughts About Air!

Grades: 5-8

Time: 5 -15 minutes

Subject: Chemistry

Topics: Properties of Gasses



Overview

What do you know about gases like air and [Carbon Dioxide](#)? In this experiment we're going to study some interesting characteristics of gas that many people don't know. Ready to don your lab coat and get started?

Let's explore further with databot™

Background



As we investigate this crazy Cave of Dogs mystery, a significant clue relates to the concepts of [volume](#), [weight](#), and [density](#).

When you walk about, do you realize you have a tremendous amount of [weight](#) from air pressing down on your body? Air actually has [weight](#), and because we can't see it and we don't feel it, many people don't think it [weighs](#) anything! In this activity you will actually "[weigh](#)" air using a highly precise balance scale that you build yourself.

In addition to [weighing](#) air, you will also get to weigh the [Carbon Dioxide \(CO2\)](#) you captured in your balloon against air! What do you think is heavier - air or CO2?

Let's explore and find out!

Objectives

Understand & Recognize:

- Gases have [weight](#), and different gases are heavier or lighter than others.
- [CO2](#) is heavier than air.

What You'll Need

- 12" round balloon filled with [CO2](#) - 1
- 12" round balloons filled with air - 2

What You'll Need (continued)

- Yardstick or Meter Stick
- Cloth measuring tape
- Binder clips - 3
- Paper Clips - 3 (to pinch off and hang your balloons)
- Pencil or Dowel
- Heavy Book / [Weight](#)

Important Terms

Carbon Dioxide (CO₂): 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 [denser](#) than a 1 cm cube of balsa wood so the [weight](#) of the gold cube is much, much heavier.

Prep (5 mins)

- Prepare the materials you will need for building your scale.
- Have [CO₂](#) captured in a balloon and ready to go for your experiment.
- Practice measuring your balloon's circumference - it can be tricky. Doing this with a partner is easier.
- Watch the video carefully and read through your instructions thoroughly!

PDQ 2 (10 mins)

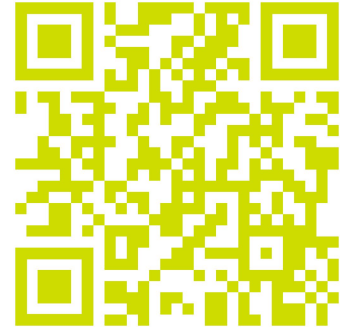


Using the QR code, study the four pictures carefully to see how you will build your own, highly sensitive scale using simple materials. This scale, although simple, is sensitive enough to [weigh](#) air - remark

Stage 1: Does Air Have Weight?!

Use the QR Code to watch the video!!

- Now, time for the big reveal - let's weigh some air. You will need two balloons filled to the same "volume" to make sure they are equal. Check this by using the cloth tape to wrap around the balloons and make sure their circumference is the same. Volume is the amount of space an object takes up, so by confirming the balloons have the same circumference you are confirming they have the same volume.
- Carefully hang each of the equal-volume balloons on either end of your scale. Do they balance?
- Now, release the air from one of the balloons by opening the clip. What happens?



State 2: What is Heavier, CO₂ or Air?

- Remove the empty air balloon and now add your CO₂ filled balloon. Again, make sure the circumference of the two balloons is the same. In order to conduct a "balanced" test, both balloons must have the same volume of gas.
- What happens? Is one balloon heavier than the other? Which gas weighs more?



Wow, you came off the blocks like a rocket!

Since you came off the blocks like a rocket in PDQ 1 and 2, are you ready for a bigger bite? Next stop, the Experiment!

Next Step, Time to Experiment!

Educator Resources

Prep

- Have your CO₂ from PDQ1 or a fresh batch ready to go in your balloon; or have your student materials ready to go for PDQ1 so they can generate CO₂ for this experiment quickly.
- There are some excellent resources for study in the Additional Resources section for deeper understanding.
- Set up the yardstick scale and experiment with it to ensure you are comfortable.
- Practice with the balloons weighing the air vs. air version and the air vs. CO₂ version.
- Be careful handling the balloons - if they develop a static charge it can be quite difficult to get them to behave in the experiment.

Objectives

Understand and Recognize:

- Gases have weight, and different gases are heavier or lighter than others.
- CO₂ is heavier than air.

NGSS

- 5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen.

Misconceptions

- Air, or gases in general, have no weight.

Guiding Questions

- What do you think will happen when we let the air out of the balloon on the scale? Do you think air has weight?
- How much do you think air weighs?

Additional Resources:

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)

Balancing Balloons, Air Has Weight
Fun Science Demos with Jared, Youtube Video

https://www.youtube.com/watch?v=o5LT_wfI98wCave 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

References:

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