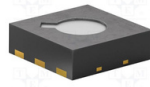


databot™ Sensor Starters

Meet the CO2 Sensor



The CO2 sensor on databot™ produces a **Carbon Dioxide Equivalent (CO2e)** value used to check the quality of air. The air we breathe provides oxygen and other essential components to fuel our cells and keep us healthy. High levels of **CO2** can displace oxygen(O2) and nitrogen (N2) causing health problems.

What Does it Measure?

The sensor measures Ethanol and Hydrogen present in the air and calculates a **CO2e** level. **CO2** is a colorless, odorless gas found in our atmosphere produced from breathing and from burning certain substances called fossil fuels. Most **CO2** in our atmosphere comes from burning fossil fuels, not from breathing.

How Does it Work?

The **CO2** sensor has a sensing element known as a 'hot-plate' that detects hydrogen(H2) molecules present in the air. The microcontroller in the sensor reads the 'hot-plate' data and calculates **CO2** levels based on the trace H2 molecules.

What Are the Units for CO2?

CO2 is measured in **parts per million (ppm)**. 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.

- High levels of CO2 can be harmful, see the table below for examples.

| CO2 Levels | Effect |
|-------------------|---|
| 250-400 PPM | Normal background concentration in outdoor ambient air. |
| 400 - 1,000 PPM | Concentrations typical of occupied indoor spaces with good air exchange. |
| 1,000 - 2,000 PPM | Drowsiness and complaints of poor air. |
| 2,000 - 5,000 PPM | Headaches, sleepiness and stagnant, stale, stuffy air. Poor Concentration, loss of attention, increased heart rate and slight nausea may also be present. |
| 5,000 PPM | Workplace exposure limit in most places. |
| >40,000 PPM | Exposure may lead to serious oxygen deprivation resulting in permanent brain damage, coma, even death. |

Important Terms

Air Quality: The quality of the air that we breathe.

Carbon Dioxide, or CO2: A colorless, odorless gas naturally present in the air you breathe.

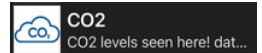
Carbon Dioxide Equivalent, or CO2e: A CO2 value calculated from the presence of Hydrogen.

Respiration: The act or process of breathing - inhaling oxygen and exhaling carbon dioxide.

- Grades:** 6 & Up
Time: 15 Minutes - PDQ 1 & 2
Subject: Physics, Science, Technology
Topics: CO₂e, CO₂, Air Quality, Respiration, ppm

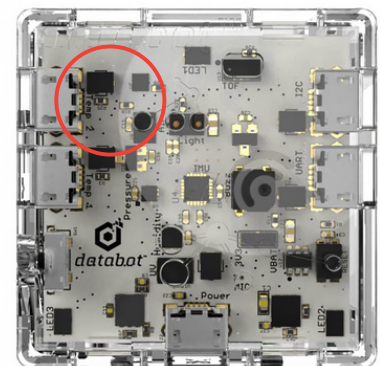
What You Will Need/Prep

- databot™ 2.0 & a smart device (iOS or Android).
- Read the Vizeey™ Fast Start Guide and install Vizeey™ if you haven't already.
- Scan the QR code for **CO2** if you don't have it already.
- Ziploc Bag - 1 (quart)
- Straw - 1




Where Does it Live?

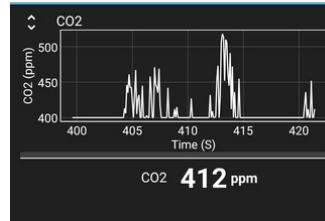
The **Air Quality/CO2** sensor is a black rectangular chip with a circle on it. Look for the label "Air" near the Temp 2 port on the databot™ PCB.



PDQ1 : Hunt for CO2!

Using the databot™ CO₂ sensor it is possible to monitor air quality. Your mission is to create a data table with your CO₂ levels and locations. Let's check for possible air quality danger!

1. Tap on CO₂ in Vizeey™ to load the experiment and use these icons to start and pause the experiment: 
2. Hold databot™ in your palm and measure CO₂ levels in various rooms. Record the CO₂ levels and locations on your data table.
3. Now, let's take this outside and measure the CO₂ levels in different environments. Try places like a garden area, terrace or near running and idle automobiles and record each CO₂ level and location in your data table.
4. What areas tested have the highest level of CO₂? Are any areas dangerously high?




Sample CO₂ level in a room

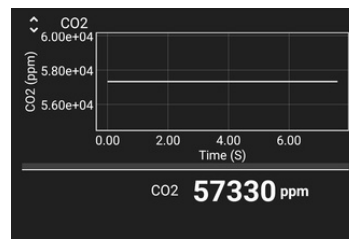
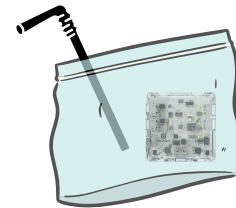
| Location | CO ₂ Level |
|----------|-----------------------|
| | |
| | |
| | |
| | |
| | |
| | |

PDQ2 : Respiration & CO2

It's time to explore the human respiratory system with databot™! Your mission is to compare CO₂ levels when breathing normally, after holding your breath, and after exercising - can you predict which one generates more CO₂?

1. Tap on CO₂ in Vizeey™ to load the experiment & use these icons to start and pause the experiment: 
2. Place databot™ in the Ziploc bag with a straw. Remove as much air as possible, and seal the bag except for the one corner with the straw.
3. Breathe in, then exhale gently into the bag through the straw. The bag will inflate. Remove the straw and seal the bag completely. Record your CO₂ level on your data table. Clear the bag and reset databot™.
4. Now, hold your breath for 30 seconds, and exhale gently into the bag through the straw, the bag will inflate. Remove the straw and seal the bag completely. Record the CO₂ level on your data table.
5. Time to get your heart rate up! Do any kind of exercise for two full minutes like jumping jacks, running in place, hopping, etc to get your heart rate up. Repeat the above experiment. Record the reading on your data table.
6. Do you we exhale more CO₂ when we are breathing normally, holding our breath or exercising? Was your prediction correct?

*Before starting the experiment make sure databot™ in an air free ziploc bag and sealed except for one corner with a straw.



Example CO₂ level

| Action | CO ₂ Level |
|----------------------|-----------------------|
| Breathing Normally | |
| After Holding Breath | |
| After Exercising | |