Sensor Starters

Grades: 4 & Up
Time: 15 Minutes -PDQ 1 & 2

Subject: Physics, Technology, Data Science, STEM
Topics: Atmospheric Pressures, Barometer, Deflection and IC.

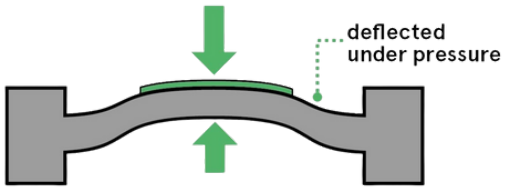
Meet the Air Pressure Sensor

The air pressure sensor senses and measures atmospheric pressure. Many types of pressure sensors exist that use different materials and methods to measure pressure. A bathroom scale, for example, is a pressure sensor! databot's sensor detects atmospheric pressure. Air pressure sensors are commonly used in GPS applications, weather station equipment, and sports watches!

Background

The air pressure sensor measures atmospheric pressure (also called barometric pressure). The atmosphere is a layer of air wrapped around the earth. The air has weight and pressure is created when it presses against everything it touches as gravity pulls it toward the center of the Earth.

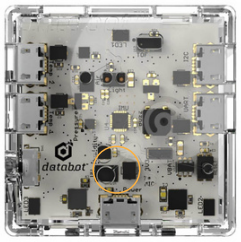
The pressure sensor consists of a sensing element, a suspended membrane, and an IC interface. When pressure is applied the membrane deflection induces an imbalance and the IC has a low noise amplifier that converts this imbalance signal into digital output.



Once the digital signal is received it can be processed and converts the imbalance to a pressure value you can use in experiments. Awesome possum!

What You Will Need/Prep

- databot™ 2.0 & Vizeey™
- IOS/Android Smart Device
- Use Vizeey™ to scan the QR Code for **Air Pressure**.
- Ziploc Bag - 1
- Straw - 1



The Air Pressure sensor is a black square chip labeled hPa for hectopascals.

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Important Terms

Atmospheric Pressure: The air around you has weight and it presses against everything it touches. That pressure is called atmospheric pressure or air pressure.

Barometric Pressure: A measurement of the air pressure from Earth's atmosphere. For this reason, it is also known as atmospheric pressure.

Deflection: The movement of a sensing element caused by air pressure.

IC: Integrated Circuit, an assembly of electronic components, fabricated as a single unit.

hPa: Pressure is measured in hectoPascals (hPa), also called millibars.

PSI: Pounds per Square Inch is another unit of measure for pressure.

What Units Do We Use to Describe Air Pressure?

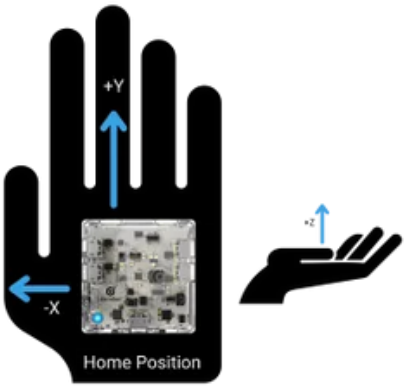
Atmospheric pressure is measured in hPa and PSI. hPa is the abbreviated name for hectopascal pressure units which is also equal to millibar pressure units - another common unit for air pressure. PSI is the abbreviated name for Pounds per Square Inch. For example the pressure resulting from a force of one pound applied to an area of one square inch would be 1 PSI.

PSI	hPa
1 PSI	68.95 hPa

Exploration Preparation!

In the coming activities you will be exploring your local environment and exploring **air pressure** using databot. databot is loaded with sensors and capabilities and it helps to have a common orientation for holding it and conducting experiments. That way if you are communicating with a partner you can communicate clearly - moving left, moving right, etc.

"Home position," shown here, is holding databot flat in the palm of your hand with the power and programming port oriented to the back of your palm. In this position sensors are facing up and you can move freely in any direction.



databot in "home position"

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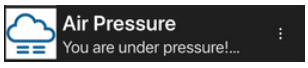
PDQ1 : Weight of Air!

Using the databot **air pressure** sensor it is possible to measure the **atmospheric pressure** and the "weight" of air on surfaces. Stretch out your palm in front of you and imagine a column of air resting on it. How much do you think the air pressing down on it weighs? Let's use databot and find out!

- Open the Vizeey App on your smart device
- Turn on databot.
- Tap on "**Air Pressure"** in Vizeey™ to load the experiment.

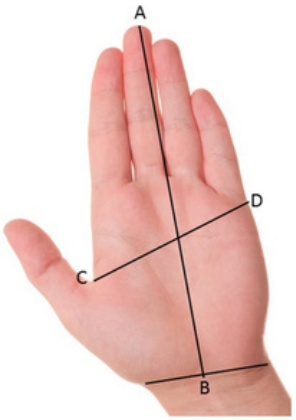


- Use these icons to start and pause the experiment:
- Hold databot™ flat on your extended palm and record the **air pressure** in **PSI**.

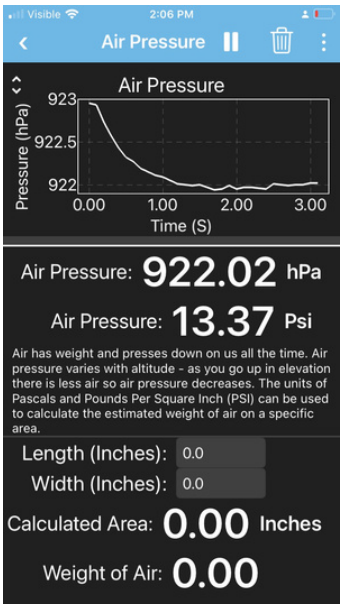
Hold databot and record the **Air Pressure** in Pounds Per Square Inch (PSI).

Now, we can find the "weight" of air pressure on your hand! First, find the approximate area of your palm.

- Measure the length and width in inches as shown.
  - length = points A to B
  - width = points C to D



*Calculate the weight of the air pressing down on your hand.



- Enter your measurements in Vizeey to calculate the area and the weight of Air!

Is the number surprising? In your own words, why don't you feel this weight on your hand?

Note: You can convert the pounds to kilograms by multiplying it by .453592

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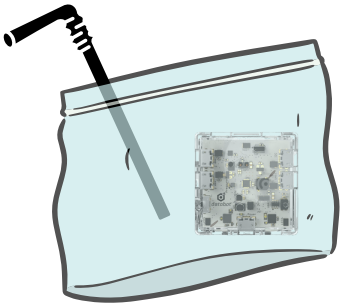
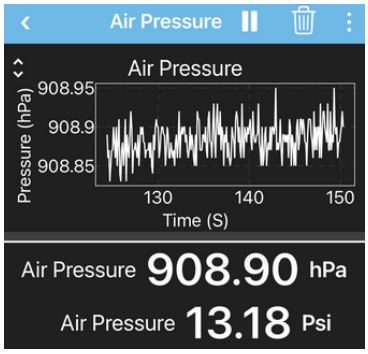
PDQ2 : Pressure Vs Volume

In PDQ 2 use the air pressure sensor to explore the relationship between air pressure and volume. Can you increase air pressure by reducing the volume?

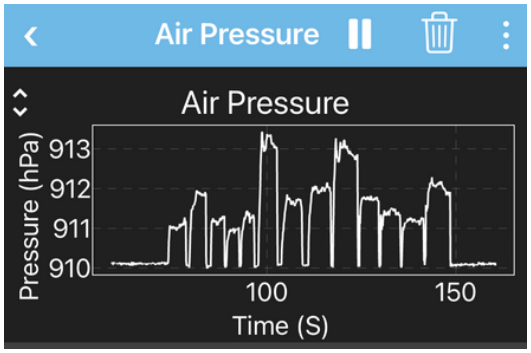


- Open the Vizeey™ App on your smart device.
- Turn on databot.
- Tap on "**Air Pressure**" *in* Vizeey™ to load the experiment.
- Place databot in a Ziploc bag with a straw.
  - Zip it mostly closed with the exception of a small space for a straw to inflate it.
  - Use the straw to blow up the bag with databot™ inside it, remove the straw, and seal the bag.
- Start and pause your experiments using :
- Squeeze and release the plastic bag and look at the air pressure readings.
  - Squeezing the bag reduces the volume the air occupies.
  - What happens to the pressure when the volume is less?

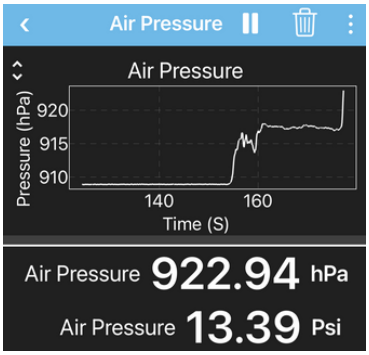


Air pressure - more volume - pre-squeeze!

Challenge: with your newfound understanding of the relationship between pressure and volume, draw a city skyline in Vizeey™ using changes in Air Pressure!



City Skyline Challenge!



Air pressure - less volume - the big squeeze!

Check for Understanding

1. In your own words, explain **air pressure**.
2. Why does **air pressure** decrease as you climb a mountain?
3. What are the units we use to express **air pressure?**

Standards & Alignment

NGSS Standards

- Matter and its Interactions (MS-PS1-1) (MS-PS1-4) (HS-PS1-1)
- Energy (HS-PS3-2) (HS-PS3-3)
- Engineering Design (HS-ETS1-1) (HS-ETS1-2)

Disciplinary Core Ideas

- PS1.A: Structure and Properties of Matter
- PS3.A: Definitions of Energy
- PS3.B: Conservation of Energy and Energy Transfer
- PS3.C: Relationship Between Energy and Forces
- HS-ETS1.B: Influence of Engineering, Technology, and Science on Society and the Natural World (Engineering, Technology, and Applications of Science)

Science and Engineering Practices

- 1st Practice: Asking Questions and Defining Problems
- 3rd Practice: Planning and Carrying Out Investigations
- 4th Practice: Analyzing and Interpreting Data
- 5th Practice: Using Mathematics and Computational Thinking
- 7th Practice: Engaging in Argument from Evidence

Crosscutting Concepts

- Patterns
- Cause and Effect
- Energy and Matter
- Scale, Proportion, and Quantity
- Systems and System Models
- Stability and Change
- Structure and Function
- Patterns and Variability

ISTE Standards

- 1.1 Empowered Learner (1.1.d)
- 1.2 Digital Citizer (1.2.b)
- 1.3 Knowledge Constructor (1.3.a) (1.3.b)(1.3.d)
- 1.4 Innovative Designer (1.4.a)(1.4.b)
- 1.5 Computational Thinker (1.5.a) (1.5.b)
- 1.6 Creative Communicator (1.6.a) (1.6.b)

TEKS -Texas Essential Knowledge and Skills

Middle School Process TEKS

7.2E Scientific investigation and Reasoning: Analyze data to formulate reasonable explanations
8.2 Scientific investigation and Reasoning: Plan and implement comparative and descriptive investigations.

Middle School Level Content TEKS

8.10B Earth and Space: Identify how global patterns of atmospheric movement influence local weather.