Sensor Starters

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

Subject: Physics, Technology, STEM
Topics: Altitude, Air Pressure, Sea Level, and Calibration

Meet the Altimeter

The Altimeter sensor calculates your current **altitude** based on **air pressure. Altimeter**s are important navigation instruments for aircraft and spacecraft pilots who monitor their height above the Earth's surface! **Altimeters** are also used by skydivers and mountaineers to pinpoint their location in the sky or on the ground.

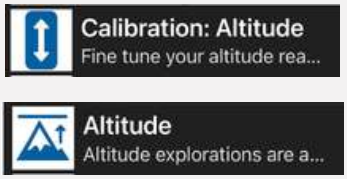
Background

The **Altimeter** measures **altitude**, how high you are above **sea level**. This is different from height, which is relative, like the height from the floor to the ceiling. **Altitude** is the distance from mean **sea level** to the point being measured. For example, the **altitude** of an aircraft is its height above **sea level**, not from the ground.
databot's **altimeter** determines **altitude** by measuring the force of **air pressure** on a pressure sensitive area in the sensor. As the **altitude** increases, **air pressure** decreases as there is less air above you.

High **Altitude**, Low Pressure

What You Will Need/Prep

- databot™ 2.0 & Vizeey™
- IOS/Android Smart Device
- Use Vizeey™ to scan the QR Code for Callibration/Altitude.



*The **air pressure** (**altimeter**) sensor is a black square chip with a tiny silver square in it. Look closely near the Temp1 port on databot for the label hPa (hPa = hectopascals - a unit of measurement of pressure) and you will see it!*

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Important Terms

- **Air Pressure:** The air around you has weight, and it presses against everything it touches. That pressure is called atmospheric pressure, or air pressure. It is the force exerted on a surface by the air above it as gravity pulls it to Earth.
- **Altimete**r: a device that measures **altitude**, the distance of a point above **sea level.**
- **Altitude**: Distance above **sea level**.
- **Calibration**: The process of matching your test instrument to a known measured quantity.
- **Sea Level**: The average level of the sea compared to land. For example, mountain heights are based on height above **sea level**.

How do we measure Altitude?

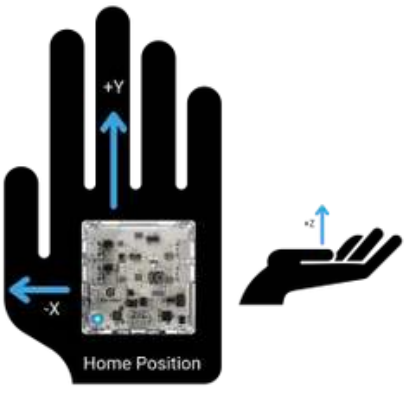
The meter (m) is a unit for **altitude**. The most widely used unit of measurement in aviation is feet. Areas are considered "high-**altitude**" if they reach at least 2,400 meters (7,800 feet) into the atmosphere.

Location	Altitude	Range
Mount Everest	Highest Altitude point on Earth	8850 (m) above Sea Level
El Alto, Bolivia	Highest Altitude City on Earth	4150 (m) above Sea Level
Dead Sea	Lowest Altitude Point on Earth	414 (m) below Sea Level
Jericho, Palestine	Lowest Altitude City on Earth	258 (m) below Sea Level

Exploration Preparation!

In the coming activities you will be exploring your local environment and identifying **altitude** 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 : Let's Get Adjusted!

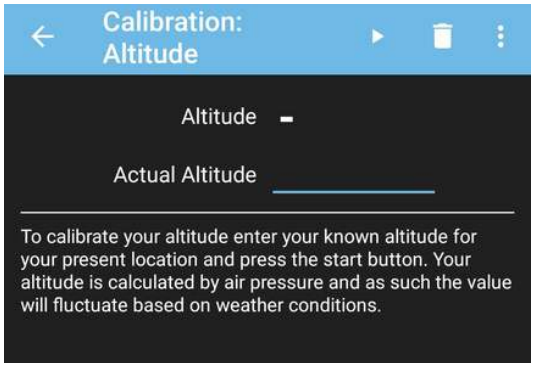
Calibration is the process of aligning (calibrating) a test instrument like databot with a known measurement. You may have **calibrate**d a scale before using a known weight and setting the scale to match that weight. databot requires an initial **calibration** of **altitude** to properly set it for your local environment:

- To **calibrate** your **altitude**, look up your **altitude** at a known location. You can use tools like Google Earth if you are not sure of your present **altitude**.

Altitude for your location in Google Earth

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

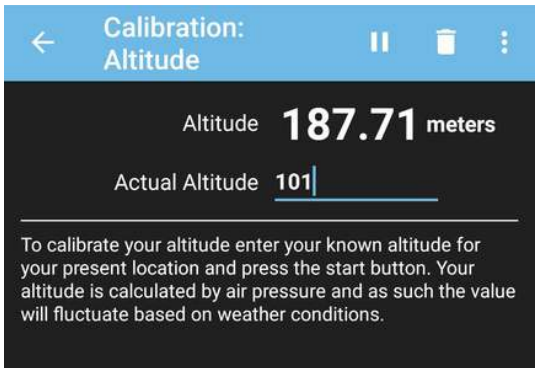
- Hold databot in the palm of your hand in "home position" and enter the known **altitude** value (in meters)as input for Actual **Altitude**.



- Use the start button and wait for the value to update.

*Before entering the actual **altitude** value

- That's it! Unless you update your firmware and overwrite your databot™ firmware it will remember this setting. If you change locations you may wish to re-calibrate.



*After entering the actual altitude value

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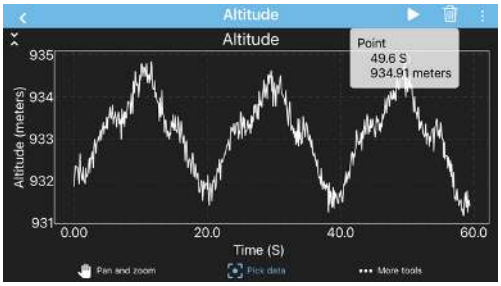
PDQ2 : Climb Up! Measure Accuracy

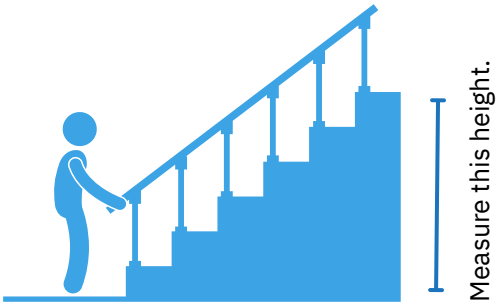
databot's **altimeter** calculates current **altitude** based on **air pressure**. Since **air pressure** constantly fluctuates due to changes in temperature and other environmental conditions databot's **altitude** will be effected. How accurate do you think the **altimeter** is based on **air pressure**? Let's find out! Find a staircase you can climb to test databot's accuracy.

Find a staircase and go up and down one flight of stairs three times. This will generate a graph similar to the one shown above. Subtract the low point from the high point to determine the height.

**Average the three values for more precision.*



- Open the Vizeey™ App on your smart device.
- Turn on databot.
- Tap on "**Altitude**" *i*n Vizeey™ to load the experiment.
- Start and pause your experiments using :
- Walk up and down the set of stairs three times while recording.
- Stop the recording, expand the graph, and use the "Pick Data" tool, identify the highest and lowest points, and subtract to determine the height according to your data.
- Now measure the staircase height with a tape measure. How close was your **altimeter** reading based on **air pressure**?



Measure the height of the stairs and compare to your findings with databot. How accurate is the **altimeter** based on **air pressure**?

Check for Understanding

1. In your own words, explain what an **altimeter** is and how it works.
2. What is the difference between **altitude** and height?
3. Why do the databot **altimeter** values fluctuate even when resting in the same location?

Standards & Alignment

NGSS Standards

- Earth's Systems: (MS-ESS2-5) (HS-ESS2-4)
- Matter and Its Interactions: 5-PS1-4
- Engineering Design: MS-ETS1-3
- MS-ETS1-3: Analyzing Data
- HS-ETS1-3: Analyzing Data

Disciplinary Core Ideas

- Physical Science (PS2.B) (PS3.A)
- Engineering, Technology, and Applications of Science (ETS1.B)
- Earth and Space Sciences (ESS2.C) (ESS2.D) (ESS3.B)

ISTE Standards

- 1.1 Empowered Learner (1.1.d)
- 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)

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
- 6th Practice: Constructing Explanations and Designing Solutions
- 7th Practice: Engaging in Argument from Evidence
- 8th Practice: Obtaining, Evaluating, and Communicating Information

Crosscutting Concepts

- Patterns
- Cause and Effect
- Scale, Proportion, and Quantity
- Systems and System Models
- Energy and matter: flows, cycles, and conservation
- Structure and function
- Stability and change

Standards & Alignment

TEKS -Texas Essential Knowledge and Skills

Middle School Process TEKS

- 6.2A Identify and describe the factors that can affect the motion of an object, including the type of force acting on the object.
- 6.2C Scientific investigation and Reasoning: Collect and record data
- 7.2E Scientific investigation and Reasoning: Analyze data to formulate reasonable explanations
- 8.2A Scientific investigation and Reasoning: Plan and implement comparative and descriptive investigations

High School Level Process TEKS

- P.2F: Scientific Investigation and Reasoning: Collect and organize qualitative and quantitative data and make measurements with accuracy and precision, using tools such as data collecting probes.

High School Level Content TEKS

- P.4A Physics: Describe and analyze motion in one dimension with the concept of frames of reference.