Sensor Starters

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

Subject: Physics, Technology, STEM
Topics: Humidity, Heat Index, Dew Point, and Capacitance

Meet the Humidity Sensor

The **humidity** sensor determines the amount of water vapor present in the air. If there is a lot of water vapor in the air, the **humidity** is high, if there is a small amount, the **humidity** is low. **Humidity** sensors are used in incubators, sterilizers, pharmaceutical processing equipment, and extensively in weather monitoring.

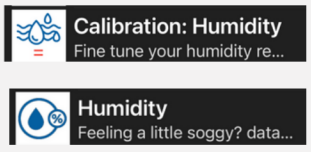
Background

The **humidity** sensor measures the relative **humidity** in the air. Depending on the temperature, the amount of water vapor in the air varies. Warm air can hold more water vapor than cool air. **Humidity** can make a hot day feel even hotter. The **heat index** is a measure of what the temperature feels like because of **humidity.** The air reaches its **dew point**, 100% RH, at the temperature when water condenses out of the air. Relative **humidity** is how the air feels at your local temperature and **humidity**.

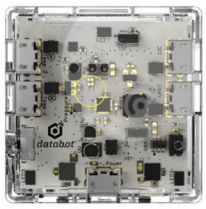
The **humidity** sensor is a small **capacitor** that consists of a dielectric material (plastic/polymer) placed in between a pair of electrodes. When the water vapor enters the dielectric layer the **capacitance** of the sensor changes. The capacitive type of sensor is direct and can measure relative **humidity** from the range of 0 to 100%.

What You Will Need/Prep

- databot™ 2.0 & Vizeey™
- IOS/Android Smart Device
- Use Vizeey™ to scan the QR Code for Callibration/Humidity.
- Ziploc bag - 1
- Straw - 1
- Rock Salt - 1 tbsp



*The **humidity** sensor is a black color square chip with a debossed circle on it. Look for the label **Humidity** near the databot logo on the databot PCB. Note there is a hole in the case for air to enter over the **humidity** sensor.*



Sensor Starters

Important Terms

Capacitance: The ability of a component or circuit to collect and store energy in the form of an electrical charge.

Capacitor: A device for storing electrical energy.

Dew Point: The temperature at which water vapor condenses is called the **dew point**.

Heat Index: The measure of what the temperature feels like because of **humidity**.

Humidity: The amount of water vapor in the air. Relative humidity is the % water vapor in the air compared to the total it will hold.

How do we measure Relative Humidity?

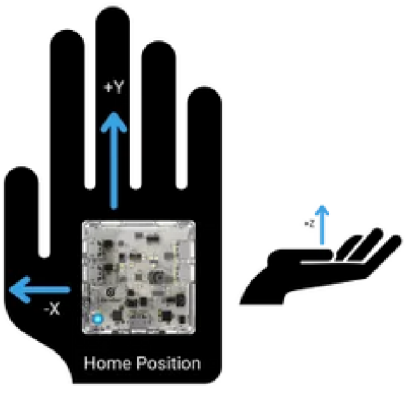
Relative Humidity (RH) is expressed as a percentage. Relative humidity is the percentage of water vapor in the air relative to the total amount of air it can hold.
RH = (actual vapor density / maximum vapor density) X 100) %

City	Temperature	Humidity	Heat Index
Phoenix	90°F	20%	90°F
Houston	90°F	90%	122°F

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"

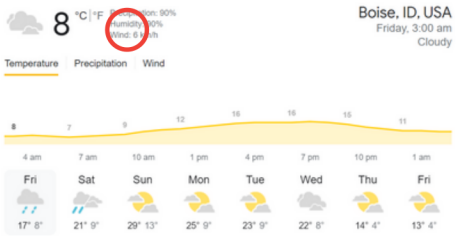
Sensor Starters

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 **humidity** to properly set it for your local environment:

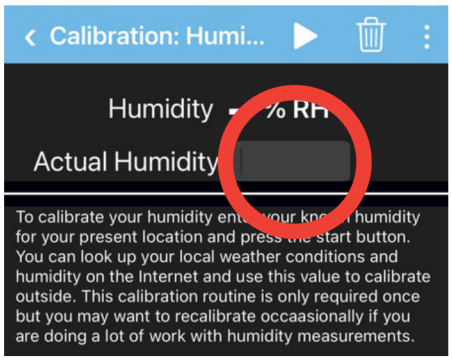
- To **calibrate** your **humidity** find the known **humidity** for your present location. You can look up your local weather conditions and **humidity** on the internet if you are not sure about it.
- Open the Vizeey App on your smart device.
- Turn on databot.

Humidity of current location in weather report



- Tap on "**Calibration: Humidity**" *i*n Vizeey™ to load the experiment.
- Hold databot in the palm of your hand in "home position" and enter the known **humidity** value as input for Actual **Humidity**.
- Use the start button and wait for the value to update.

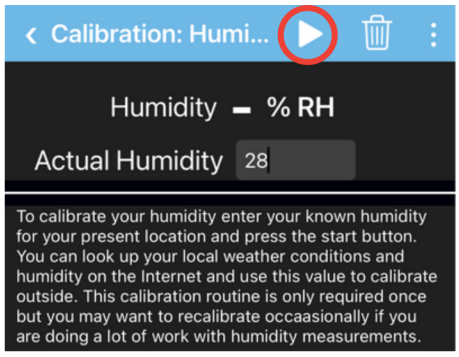
*Before entering the actual **humidity** value



Enter the actual Humidity 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 humidity value



Use the Start button to begin experiment

Sensor Starters

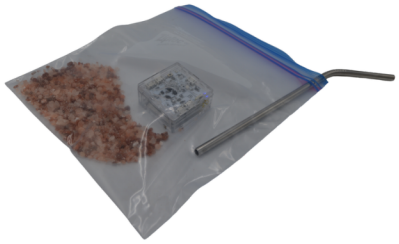
PDQ2 : Salt vs. Humidity!

databot's humidity sensor calculates the relative humidity based on the water vapor (moisture) in the air. Is it possible to control the moisture in the air using external agents? Let's experiment with databot to find out!

- Open the Vizeey™ App on your smart device.
- Turn on databot.
- Tap on "**Humidity**" *i*n Vizeey™ to load the experiment.
- Start and pause your experiments using :
- Place databot inside a Ziploc bag with 1 tbsp rock salt.
  - Zip the bag closed with the exception of a small space for a straw.
- Use the straw to breathe into the bag to inflate.
  - Remove the straw carefully without squeezing the bag.

*Important- your breath is loaded with water vapor so the humidity in the bag will be high.

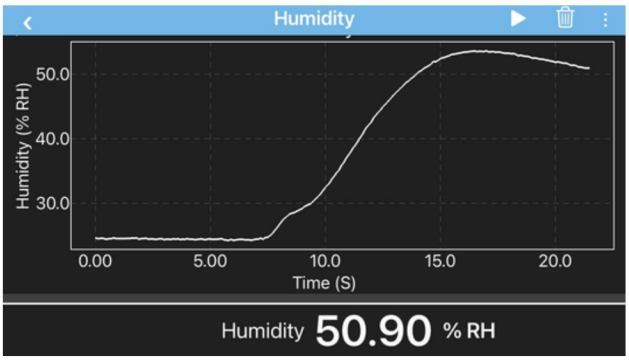
databot placed inside a closed Ziploc bag that has rock salt and straw inserted.

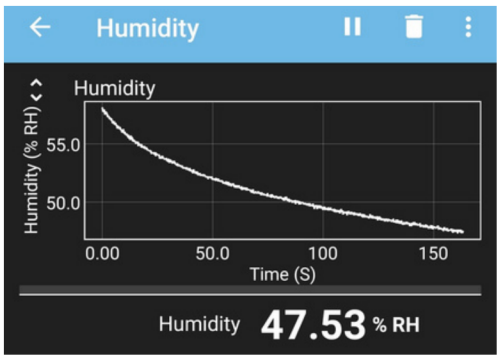


Rock salt is "hygroscopic" meaning it absorbs moisture. Why?

- Watch the data carefully.
  - Do you see a gradual decrease in relative humidity?
  - What happens to moisture in the air when it comes into contact with rock salt?
  - Why do you suppose rock salt "dries" the air out?
  - Can you think of real world applications where this might be useful?

Decrease in Relative Humidity Over Time





Check for Understanding

1. In your own words, explain **humidity**.
2. Explain the purpose of **calibrating** your databot to local **humidity** levels.
3. Why does the **humidity** level increase inside a bag when you breathe into it?

Standards & Alignment

NGSS Standards

- Earth's Systems: (MS-ESS2-5) (HS-ESS2-5) (HS-ESS2-6)
- Matter and Its Interactions: MS-PS1-1
- Engineering Design: HS-ETS1-3
- MS-ETS1-3: Analyzing Data
- HS-ETS1-3: Analyzing Data

Disciplinary Core Ideas

- Physical Science PS1.A
- Engineering, Technology, and Applications of Science (ETS1.A) (ETS1.B) (ETS1.C)
- Earth and Space Sciences (ESS2.D) (ESS3.C)

ISTE Standards

- 1.1 Empowered Learner (1.1.c)
- 1.2 Digital Citizen (1.2.c)
- 1.3 Knowledge Constructor (1.3.c)
- 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)

Crosscutting Concepts

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

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

Standards & Alignment

TEKS -Texas Essential Knowledge and Skills