

Sensor Starters

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

Subject: Physics, Technology, STEM
Topics: Temperature, Celsius, Fahrenheit, Resistance, Endothermic Reaction.

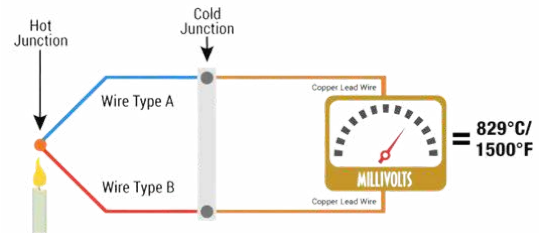
Meet the Temperature Sensor

The temperature probe (sensor) measures temperature when placed on a surface, inserted into an object, or submerged in liquid. Temperature probes are used in Heating, Ventilation, Air Conditioning (HVAC), medical, food, pharmaceutical, and many other industries to monitor the temperature.

Background

The temperature probe measures temperature, a measure of hotness or coldness of a material. Temperature is the degree or intensity of the heat present in a substance or a system. The change in temperature is based on the amount of heat released or absorbed.

The temperature probe works by monitoring the change in resistance of the given area (solid/liquid/gas) and converts it into readable data. The probe has two metals whose resistance varies with change in temperature.



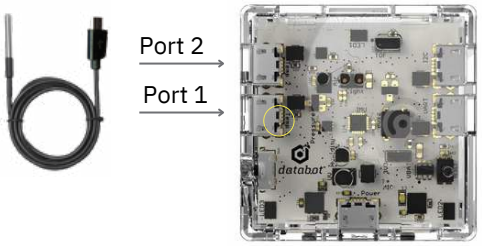
The amount of current passing is converted to temperature.

What You Will Need/Prep

- databot™ 2.0 & Vizeey™
- IOS/Android Smart Device
- Use Vizeey™ to scan the QR Code for Callibration/Humidity.
- Baking Soda
- Vinegar
- Beaker or Jar - 1

Temperature Probe
Use your waterproof temp...

The temperature probe is an external, waterproof sensor included with databot. databot has two dedicated ports to connect temperature probes, which are located on the left hand side. Just above the power switch. When only one probe is used connect it to the Port 1 on databot.



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Important Terms

Celsius: (symbol: °C) An international, standard temperature scale in which 0°C is the freezing point of water and 100°C is the boiling point.

Endothermic Reaction: A type of chemical reaction that requires energy to take place. When this happens you will see a drop in temperature in your reactants.

Fahrenheit: (Symbol °F) A temperature scale used in the United States in which water freezes at 32°F and boils at 212°F.

Resistance: The measure of opposition to the current flow in a material.

Temperature Probe: A type of sensor used to measure the temperature of any material it touches.

How do we measure Temperature?

Temperature is most often expressed in Celsius and Fahrenheit scales.

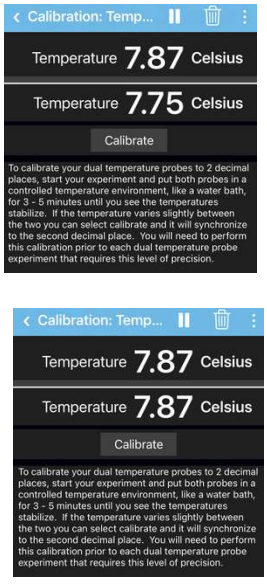
0°C = 32°F

Condition	Temperature in °C	Temperature in °F
Freezing temperature of Water	0°C	32°F
Boiling temperature of Water	100°C	212°F
Normal body temperature range	36.1°C to 37.2°C	97°F to 99°F

Exploration Preparation!

In the event you want to use two probes at the same time you may want to calibrate them. Calibration is the process of aligning (calibrating) a test instrument like databot™ with a known measurement. You may have calibrated a scale before using a known weight and setting the scale to match that weight.

databot has the ability to read two temperature probes simultaneously, and if you are doing a comparative experiment with two probes you may want to calibrate them to match exactly. Each probe will vary slightly in its starting state, but you can synchronize probes to two decimal places using the calibration experiment in your databot System Tools. Calibration will align temp probe #2 with the exact value of #1.



Dual temperature probe readings before and after calibrating.

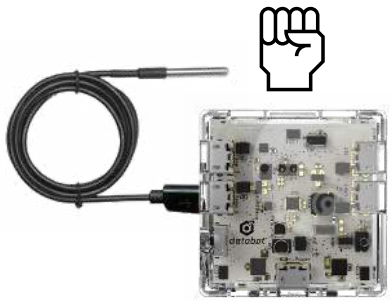
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PDQ1 : Give Me a Hand Please!

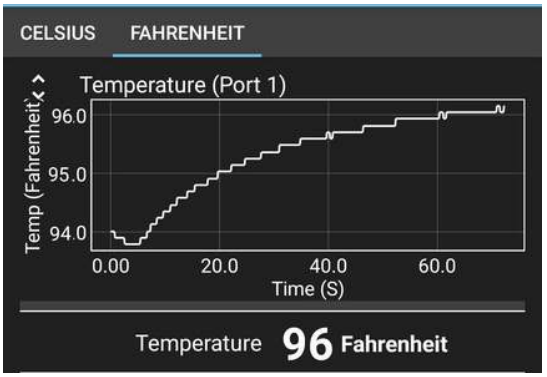
Using the temperature probe it is possible to measure the temperature of the material on which it is placed. Let's start by finding your own body temperature. Is your temperature normal? Let's check it.

- Open the Vizeey App on your smart device.
- Turn on databot.
- Tap on "Temperature" *in* Vizeey™ to load the experiment.
- Use these icons to start and pause the experiment.
- Start your experiment using:
  - observe the data. Keep your hand closed for **60** seconds.
- Use the start button and wait for the value to update.
- When you feel the temperature is constant, pause the experiment.
  - This will record your temperature in Celsius and Fahrenheit.
  - Swipe right or left on the screen to change views between Celsius and Fahrenheit.
- Compare your temperature with the normal body temperature range given in the table on page 2. Is your temperature normal/low/high?

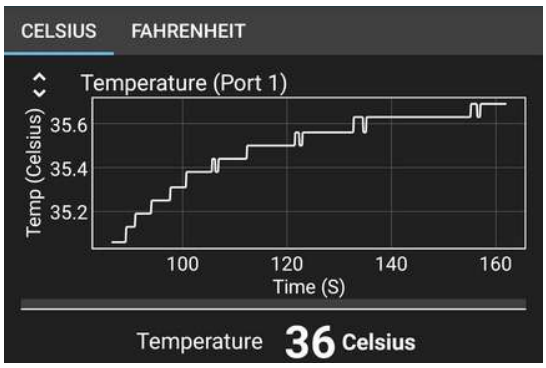
***Challenge**: Friction generates heat. Challenge your classmates to achieve the highest possible temperature by rubbing their hands together. How many degrees above your recorded body temperature can you reach?*



Connect the temperature probe to the Temp 1 port and hold it tightly in your clenched fist.



Example of temperature shown in Fahrenheit



Example of temperature shown in Celsius

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PDQ2 : Chemical Reaction Vs Temperature!

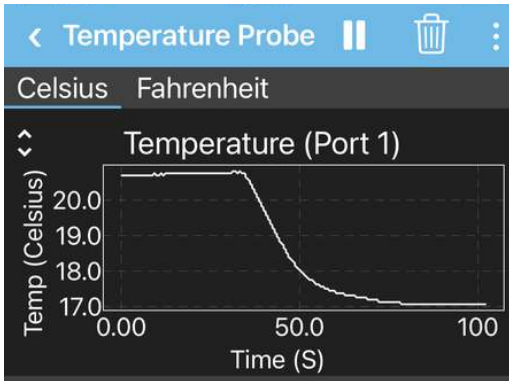
In PDQ 2 use the temperature probe to record the change in temperature when two substances (baking soda + vinegar) react with each other. You should see a decrease in temperature as this is an endothermic reaction that requires energy.



- Open the Vizeey™ App on your smart device.
- Turn on databot.
- Tap on "**Temperature**" *i*n Vizeey™ to load the experiment.
- Start and pause your experiments using :
- Connect the temperature probe to databot's Temp 1 port.



- Add baking soda to a container and measure the temperature.
- Now add measured amounts of vinegar to the baking soda and watch the temperature decrease. This is called an **endothermic reaction.**



Example of Endothermic Reaction

- Create a series of controlled experiments in which you use the same amount of baking soda each time. Add increasing amounts of vinegar using precise measurements and write down the temp change each time.

Baking Soda	Vinegar	Temperature Start	Temperature End	Temperature Change
1 tbsp				
1 tbsp				
1 tbsp				
1 tbsp				
1 tbsp				

Challenge! *After your study, can you determine the exact amount of vinegar needed to create a controlled reaction that will raise the temperature exactly three degrees Celsius? Go science!*

Check for Understanding

1. In your own words, explain **temperature.**
2. Explain the difference between the **Fahrenheit** and **Celsius** temperature scales.
3. Why does the **temperature** decrease in an **endothermic reaction**?

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

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
6.5C Matter and Energy: Identify the formation of a new substance by using the evidence of a chemical change
8.5E Matter and Energy: Investigate how evidence of a chemical reactions indicate the formation of a new substance.

High School Level Process TEKS
C.2H: Scientific Investigation and Reasoning: Organize, analyze, evaluate, make inferences, and predict trends from data.

High School Level Content TEKS
C.11C: Matter: Classify reactions as exothermic or endothermic