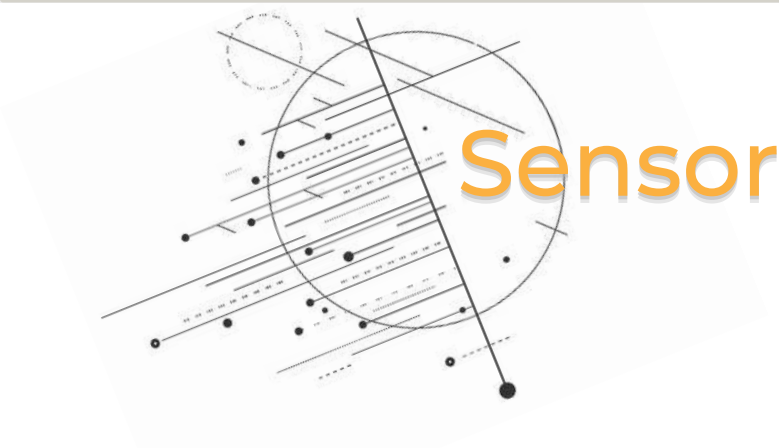


Sensor Starters

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

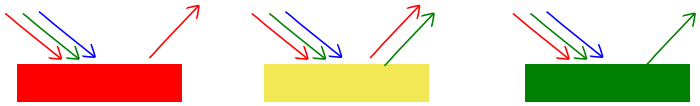
Subject: Physics, Technology, Data Science, STEM
Topics: Ambient Light, Illuminance, Color sensor

Meet the Color Sensor

The color sensor measures red, green, blue, and clear light **illuminance** by receiving **ambient light**. It detects the **illuminance** of light reflected from an object and differentiates the primary colors like red, green, and blue. Color sensors are widely used to grade and monitor color consistency in various industries, such as ensuring food packaging maintains its intended color or verifying that textile fabrics match specified color standards.

Background

The color sensor measures the **illuminance** of reflected light with **RGB** values. When an object is irradiated with light containing **RGB** components, the color of the reflected light will change depending on the color of the object. For example, if the object is red, the reflected light component will be red. For a yellow object, the reflected light will be red and green, and if the object is white all three components will be reflected.



Object Color	Reflected Light		
	Red	Green	Blue
Red	+		
Yellow	+	+	
Green		+	
Blue			+
White	+	+	+
Black			

What You Will Need/Prep

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

The color sensor is just one of the sensors in a module that is located top center of your databot . It is a multifunction module labeled as Light that also senses light and gesture.

Sensor Starters

Important Terms

Ambient light: Ambient lighting is essentially indirect lighting that fills a room.

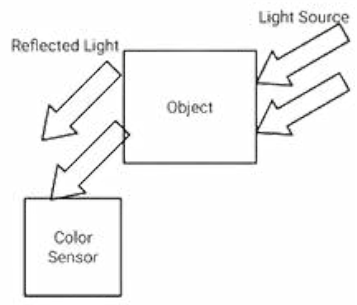
Illuminance: The measurement of the amount of light falling and spreading over a given surface area.

Lux (Lx): A unit of light measurement where the area is taken into account.

RGB: An abbreviation for Red, Green, and Blue light.

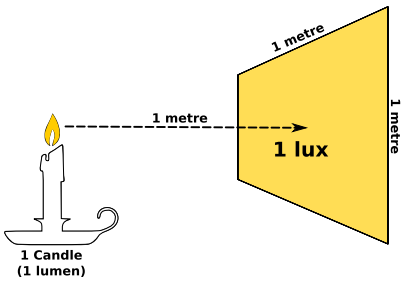
How Does it Work?

The color sensor contains sensitive filters, sensor arrays, LED, target surfaces, and a receiver. When white light is illuminated on the target, then the sensor is activated with 3 filters, which have 3 different wavelengths and determines the color of the target with respect to the RGB scale.



What Are the Units for Illuminance?

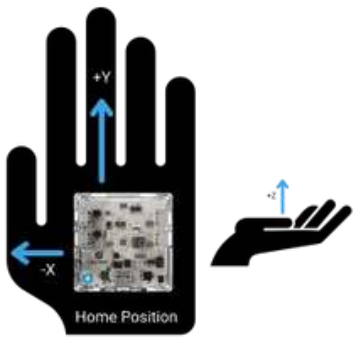
Lux is a unit of light measurement where the area is also taken into account. In other words – light intensity over a specific area. **Lux** is used to measure the amount of light output in a given area.



Exploration Preparation!

In the coming activities you will be exploring your local environment and identifying color levels 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.



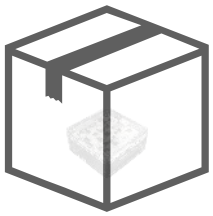
databot in "home position"

Sensor Starters

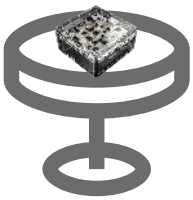
PDQ1 : Dark and Light

Use the databot color sensor to find the RGB scale of light in your room! Your mission is to find the RGB scale of **illuminance** in your room in different conditions of light. Create the data table and record the RGB values.

- Open the Vizeey App on your smart device
- Turn on databot
- Tap on **"Color"** in Vizeey™ to load the experiment.
- Use these icons ▶ ⏸ to start and pause the experiment.
- Place databot on the table and turn off all the lights in the room or place your databot inside a cardboard box. Record the **illuminance/lux** value and the light condition.
- Next, record the **illuminance/lux** value by changing the light conditions of the room to dim light, bright light, and focused light (torch light) by placing your databot on the table.
  - You can also use a color-changing lamp.



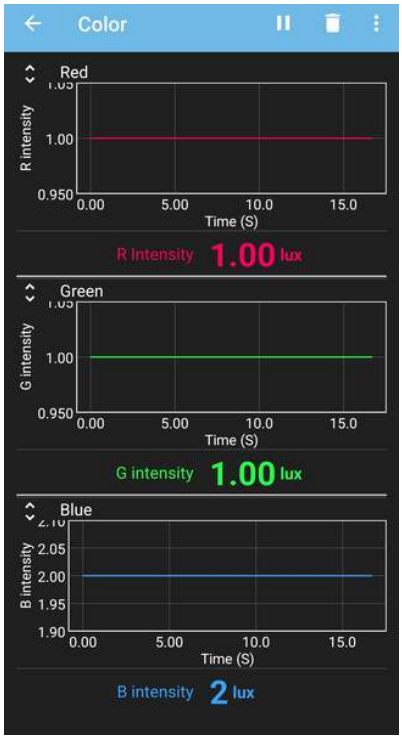
Dark condition



Light condition

Example Data table

Condition	Red	Green	Blue
Dark room			
Dim Light			
Bright Light			
Focused Light			



RGB Scale in Dark condition

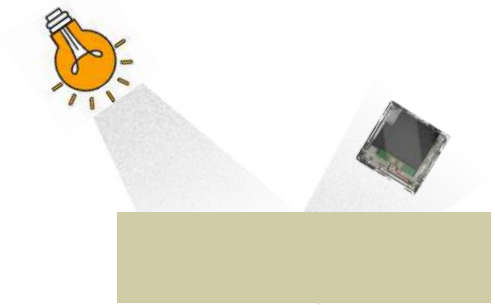
Analysis: Of the values recorded which color among the RGB is always prominent in all light conditions?

Sensor Starters

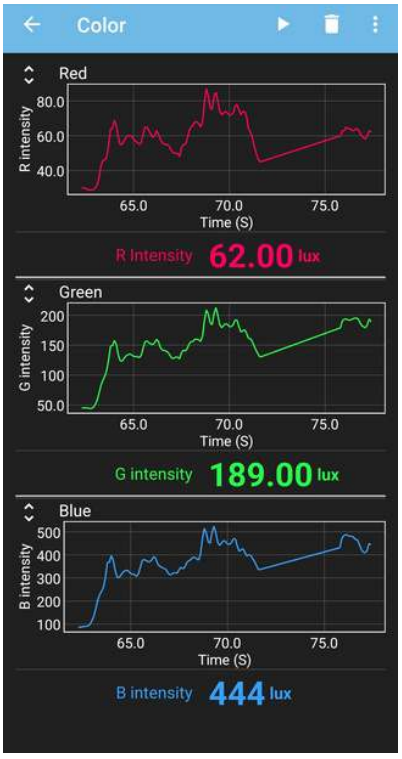
PDQ2 : Color Codes!

Using the databot color sensor it is possible to detect the color of an object from the light reflected from the object. Your mission is to record the RGB scale **illuminance** of light reflected from different colored objects. Create a data table and record the RGB values with the object's name, color and type.

- Open the Vizeey App on your smart device
- Turn on databot
- Tap on **"Color"** in Vizeey to load the experiment.
- Use these icons ▶ ⏸ to start and pause the experiment.
- Place the light source in front the object.
  - The object may be a colored paper, colored cardboard, or colored cloth.
- Place your databot facing towards the object, so that the reflected light will hit your databot.
- Record the **RGB illuminance** scale of the reflected light, name, color, and type of the object as shown in the example data table.
- In the similar fashion record the **RGB illuminance** for different colored objects other than primary colors like: brown, purple, pink, magenta, turquoise, etc.



Measuring RGB scale of cardboard from the reflected light



Example Data table

Object	Color	Red	Green	Blue
Paper	Turquoise	62	189	444

Check for Understanding

1. What does RGB stand for?
2. Where would a color sensor be useful, can you think of a real-world application?
3. What did you notice about RGB readings when in dim versus bright light?

Standards & Alignment

NGSS Standards

- Waves and Their Applications in Technologies for Information Transfer (4-PS4-2) (MS-PS4-2)(HS-PS4-4)

Disciplinary Core Ideas

- Wave Properties (PS4.A)
- Electromagnetic Radiation (PS4.B)

Science and Engineering Practices

- 2th Practice: Developing and using models
- 3rd Practice: Planning and Carrying Out Investigations
- 4th Practice: Analyzing and Interpreting Data

Crosscutting Concepts

- Cause and Effect
- Energy and Matter

ISTE Standards

- 1.1 Empowered Learner
- 1.3 Knowledge Constructor
- 1.4 Innovative Designer
- 1.5 Computational Thinker

TEKS -Texas Essential Knowledge and Skills

- Science:

Grade 4 (112.15):
  - (b)(10)(A): Explore the effects of light energy, including reflection and absorption, by measuring illuminance.
  - (b)(10)(B): Demonstrate how light interacts with materials to produce visible effects.

Grade 6 (112.18):
  - (b)(8)(C): Investigate how light behaves through reflection and refraction.

Grade 7 (112.19):
  - (b)(8)(A): Identify characteristics of light energy and how it interacts with matter.

- Mathematics TEKS:

Grade 4 (111.6):
  - (b)(5)(A): Use measurement concepts to analyze lux values and RGB data.
  - (b)(7)(A): Solve problems using data representations.

Grade 7 (111.19):
  - (b)(10)(A): Create data tables and analyze light intensity variations.

- Technology Applications TEKS:

Grades 6–8 (126.14–16):
  - (c)(2)(A): Create and use databases to record light sensor readings.
  - (c)(3)(C): Use digital tools to create representations of light data for analysis.
  - (c)(4)(B): Collect and analyze data using the Databot and Vizeey app.