Introduction to Color Sensors

TI Precision Labs – Light Sensors

Presented by Rahland Gordon

Prepared by Rahland Gordon, Alex Bhandari-Young and Karthik Rajagopal

How the Eye Sees Light

- Two type of photoreceptors
  - Rods: used in low light conditions
    - Sense brightness
  - Cones: used in well lit conditions
    - Sense both brightness and color

- There are three types of cones: long (L), medium (M) and short (S)

- Each cone type is sensitive to different parts of the visual spectrum, enabling color perception



Human Cone Spectral Responce
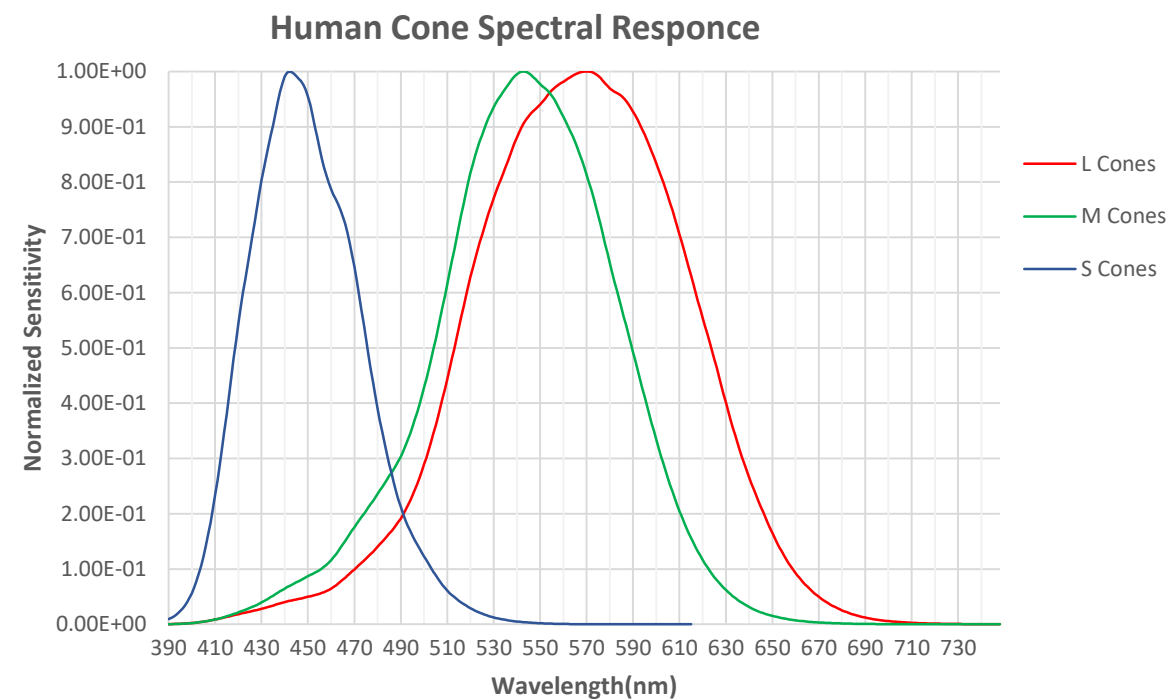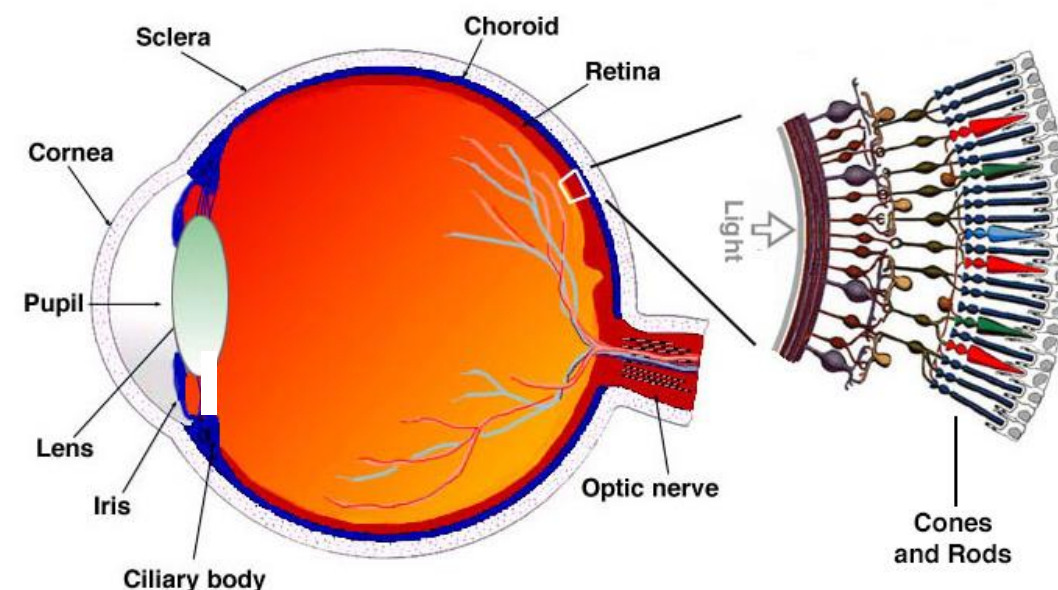
The Colors We See

- Visible light
  - 380 to 750nm
  - White light is a mixture of all colors
  - Black is a total absence of light
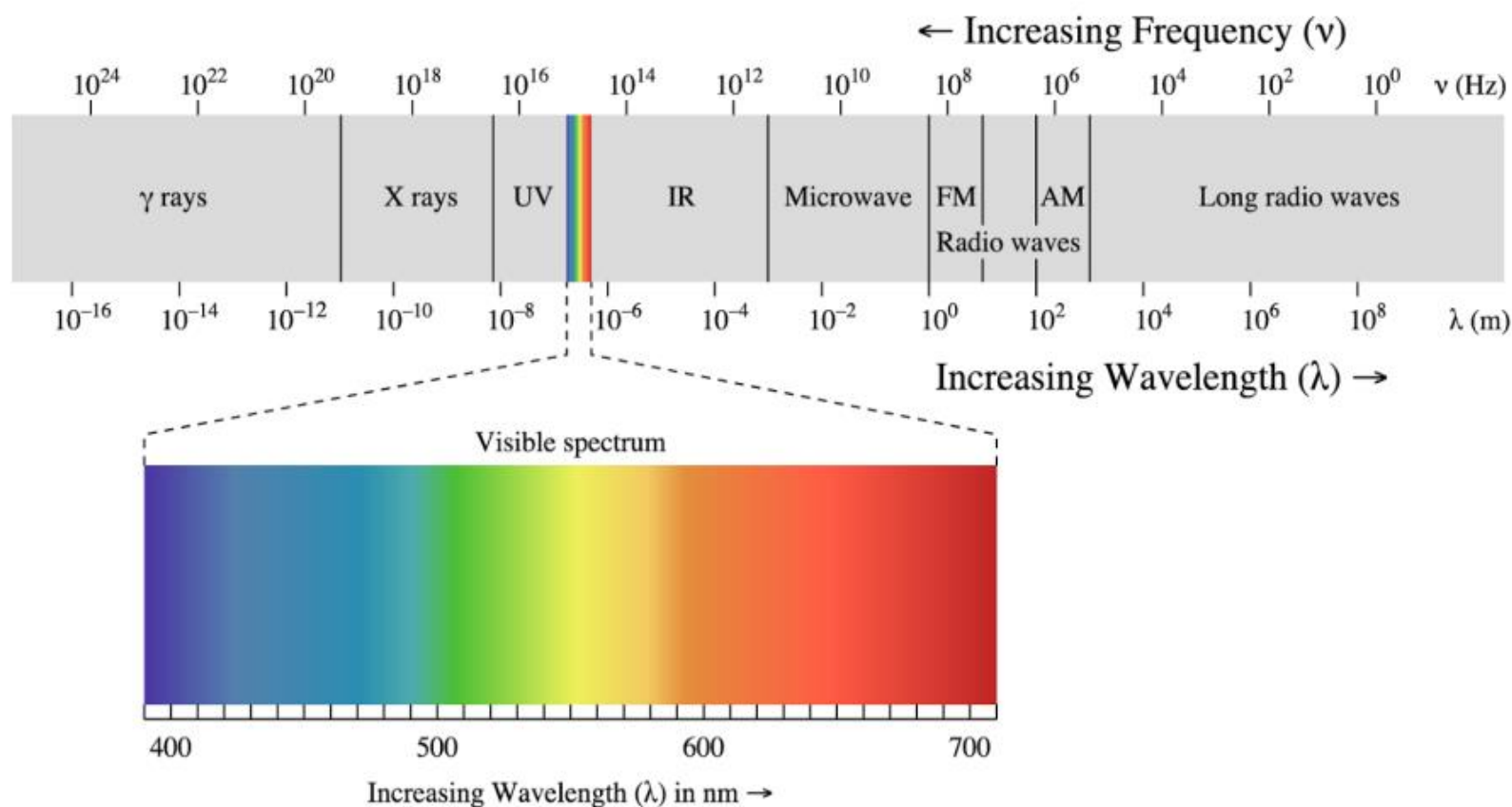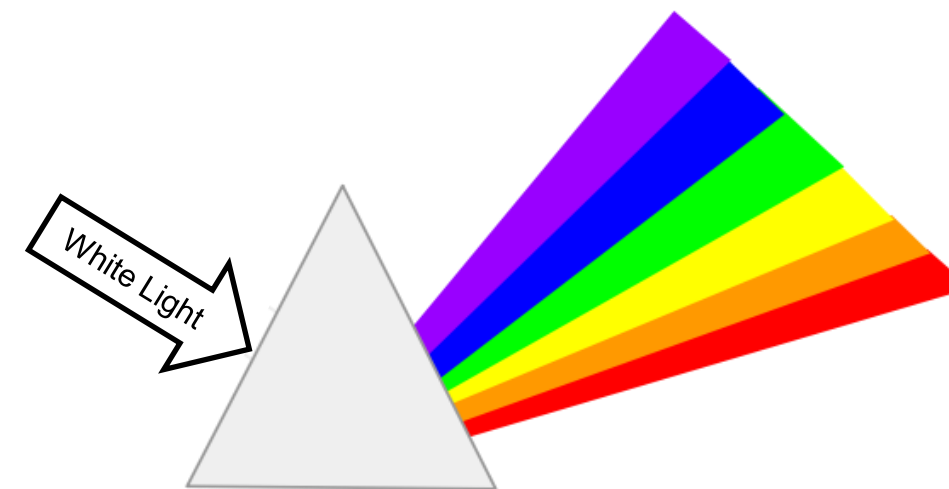
Color	Wavelength Range (nm)
Violet	~380 – 410
Indigo	~410 – 450
Blue	~450 – 500
Green	~500 – 570
Yellow	~570 – 590
Orange	~590 – 620
Red	~620 – 750

How Colors are Created

- 2 processes in which color is created:
  - Subtractive Color Process
  - Additive Color Process

- **Subtractive**:
  - Light reflected back is the color we see

- Additive:
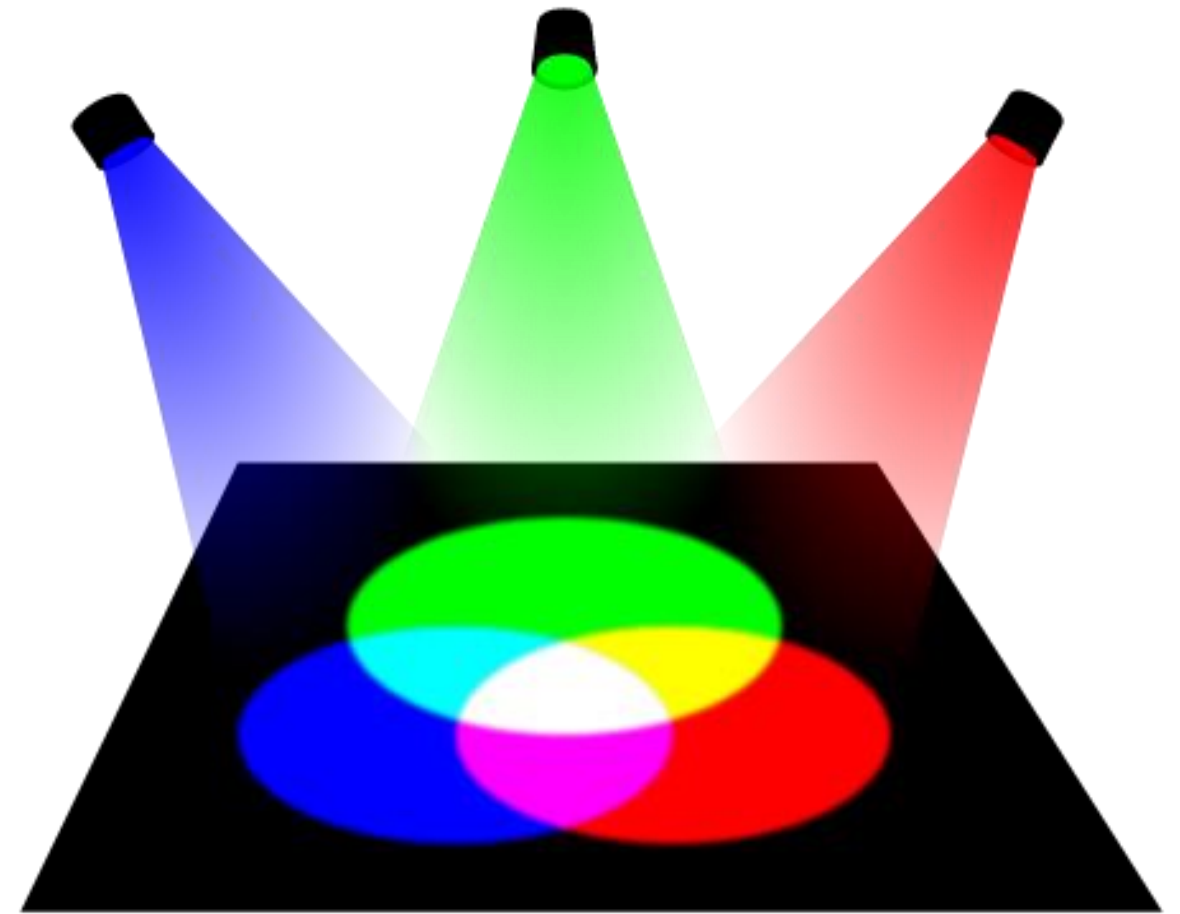 - Summation of narrow bands of visible light
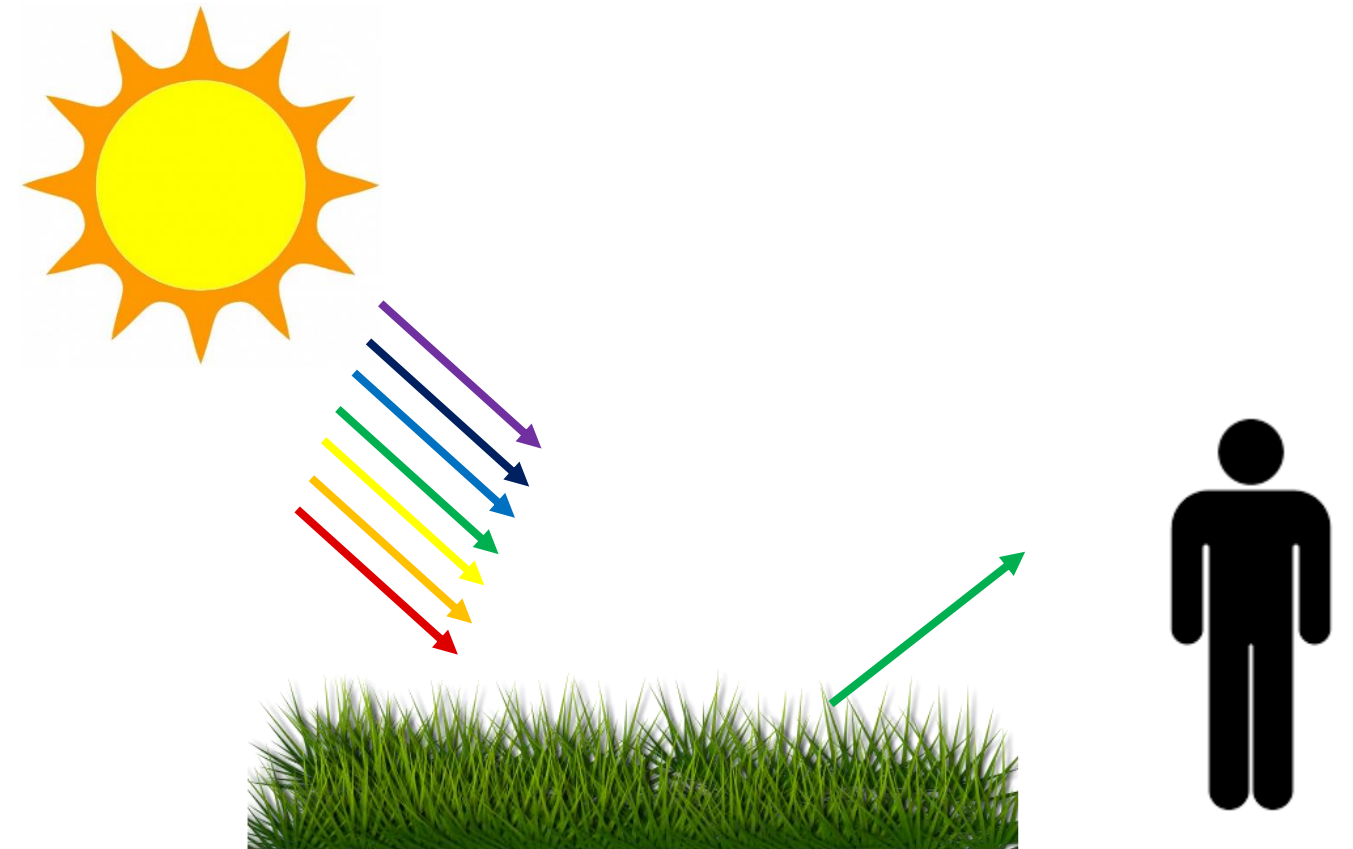
How Colors are Created

- 2 processes in which color is created:
  – Subtractive Color Process
  – Additive Color Process

- Subtractive:
  – Light reflected back is the color we see

- **Additive**:
  – Summation of narrow bands of visible light

Color Temperature

- Color Temperature:
  - Perceived color of light
  - Measured in degrees Kelvin (K)

1000 2000 3000 4000 5000 6000 7000 8000 9000 10000 11000 12000

- Correlated Color Temperature (CCT):
  - Color temperature of light sources that don't produce light from a heated element
  - Measured in degrees Kelvin (K)
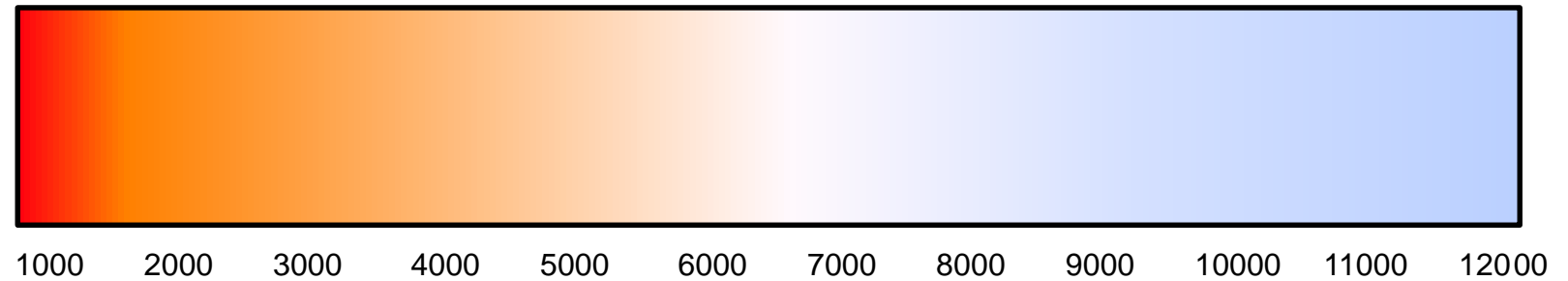
| <u>Warm</u> | <u>Neutral</u> | <u>Cool</u> |

TEXAS INSTRUMENTS

Color Spaces and Standards

- Color Spaces:
  - 3-Dimensional space to describe color and brightness of light

- RGB color space:
  - Cannot capture all perceivable colors

- CIE 1931 XYZ color space:
  - Represents all perceivable colors
  - Brightness is a function of Y and linear to lux

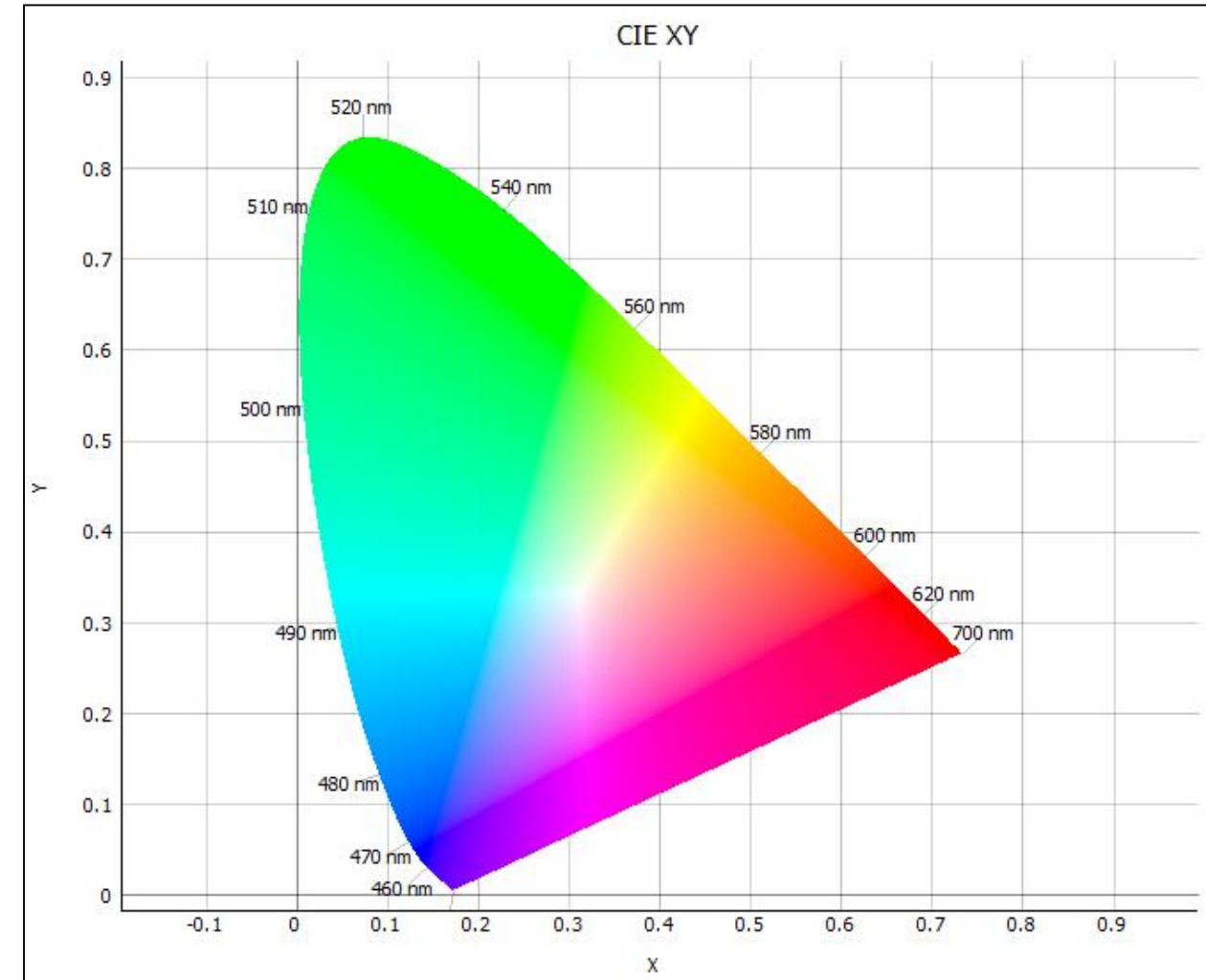- If brightness information is removed, color can be described in a 2D space (x,y)
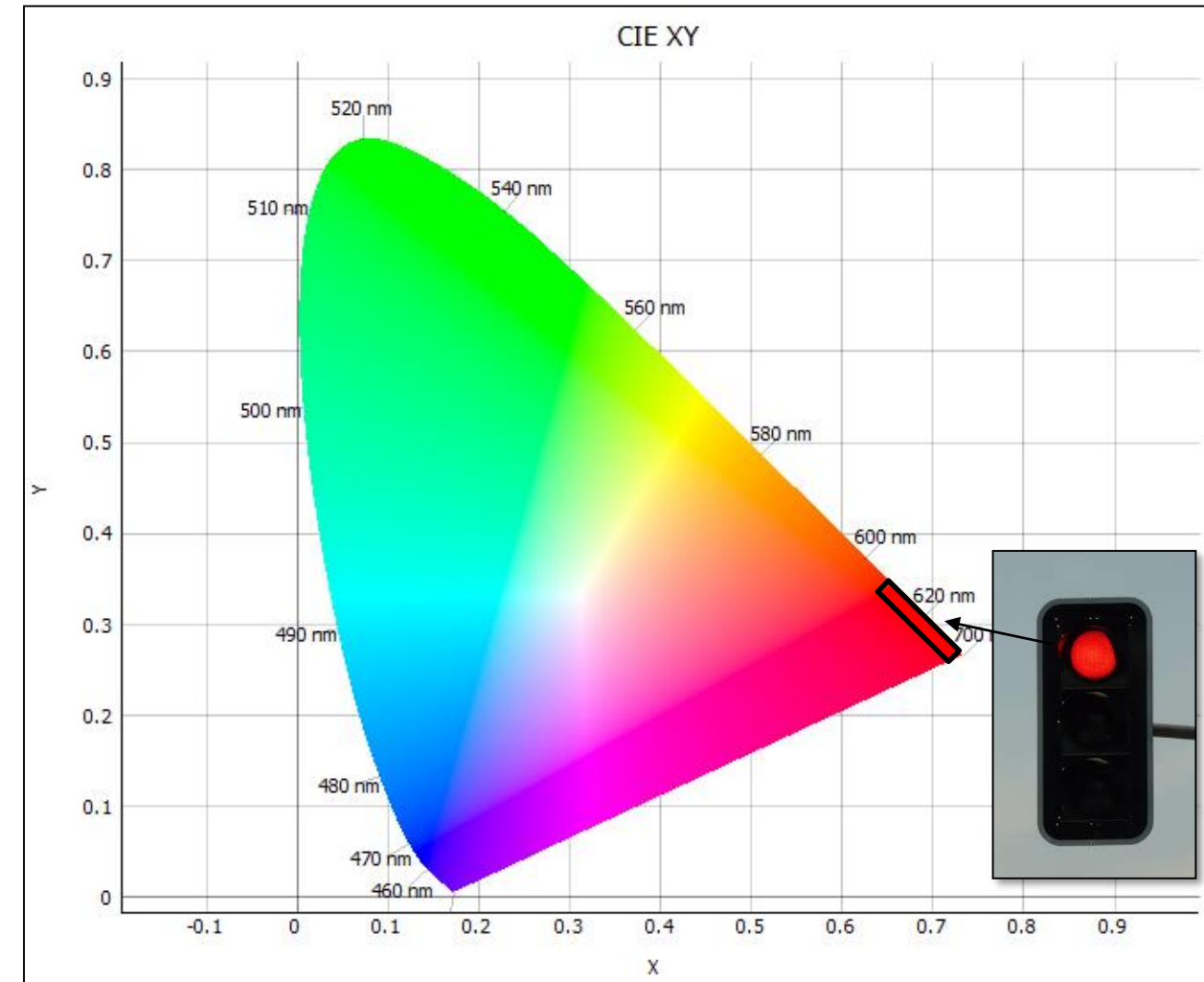
Color Spaces and Standards

- Color Spaces:
  - 3-Dimensional space to describe color and brightness of light

- RGB color space:
  - Cannot capture all perceivable colors

- CIE 1931 XYZ color space:
  - Represents all perceivable colors
  - Brightness is a function of Y and linear to lux

- If brightness information is removed, color can be described in a 2D space (x,y)

Why Measure Color

- Data from color sensor:
  - Ambient light brightness
  - Light color characteristics
    - CCT, 3-dimensional color coordinates, etc

- Use cases:
  - Adjust color profile of a display
  - Adjust brightness of a display
  - Image correction for cameras
  - Color matching
    - Ex. Copy color for paint matching

To find more light sensor technical resources and search products, visit ti.com/ambientlightsensors

Thanks for your time! Please try the quiz.

Quiz

What does Correlated Color Temperature (CCT) represent?

    a) How hot or cold a light source is

    b) How bright a color is

    c) How warm or cool a light source appears

    d) How close a color matches the color of the sun

Quiz

What does Correlated Color Temperature (CCT) represent?

    a) How hot or cold a light source is

    b) How bright a color is

    c) How warm or cool a light source appears

    d) How close a color matches the color of the sun

Quiz

Does the CIE 1931 XYZ color space represent all perceivable colors?

    a) Yes

    b) No

Quiz

Does the CIE 1931 XYZ color space represent all perceivable colors?

    a) Yes

    b) No