

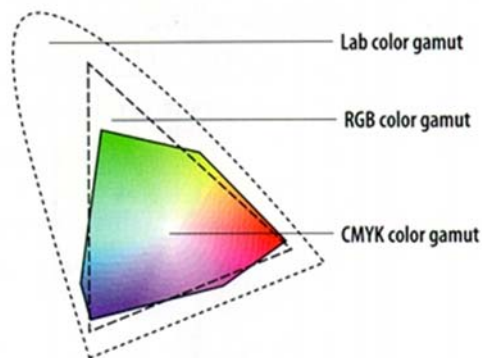
# Color Perception

**Paint** (subtractive)

Illumination

+

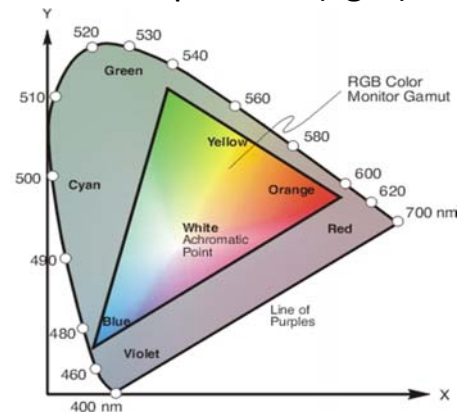
Surface & color of object (paint)



Cone sensitivity of human eye

**Light** (additive mixing)

Color composition (light)



Cone sensitivity of human eye

## Information Visualization MOOC

### Unit 7: Dynamics & Deployment

### Color Perception and Reproduction

#### Relevant Research Disciplines:

Psychology, Design, Cartography, Information Visualization

# Terminology

**Color Space** is a mathematical model for describing color.

Examples:

RGB (red, green, blue) - additive

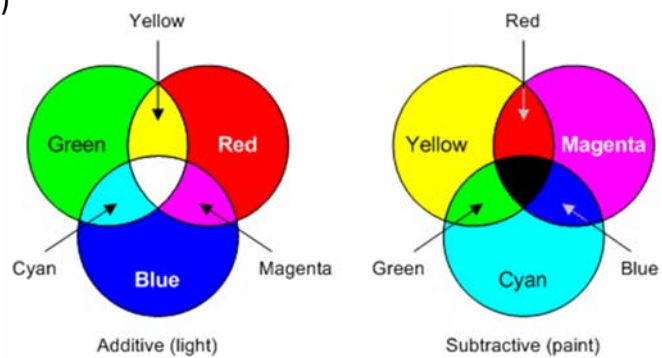
CMYK (cyan, magenta, yellow, black) - subtractive

HSB (hue, saturation, brightness)

HSV (hue, saturation, value)

HLS (hue, lightness, saturation)

Some models are additive,  
others are subtractive.

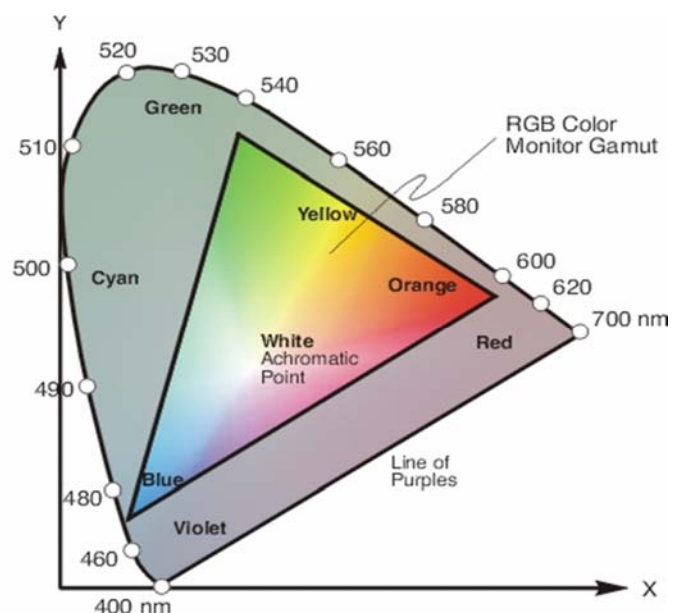


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## Example of Additive RGB Color Mixing Space

Emitting surfaces (e.g., computer screens) use three primary colors: red, green, and blue.

Only colors that fall within the triangle defined by these three colors can be produced.



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# Color Perception

When using  
**Paint** (subtractive)

Color perception depends on:

Illumination

+

Surface & color of object (paint)

+

Cone sensitivity of human eye

**Light** (additive mixing)

Color composition (light)

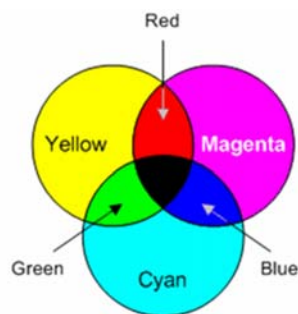
+

Cone sensitivity of human eye

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# Color Perception

**Paint** (subtractive)



Illumination

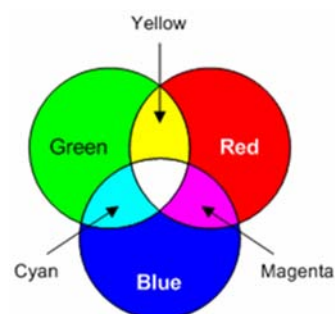
+

Surface & color of object (paint)

+

Cone sensitivity of human eye

**Light** (additive mixing)



Color composition (light)

+

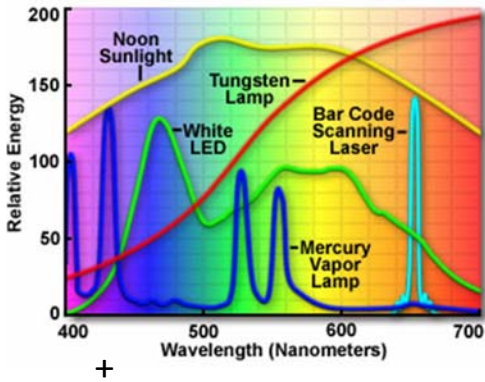
Cone sensitivity of human eye

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# Color Perception

**Paint** (subtractive)

Illumination



Surface & color of object (paint)

+

Cone sensitivity of human eye

**Light** (additive mixing)

Color composition (light)

+

Cone sensitivity of human eye

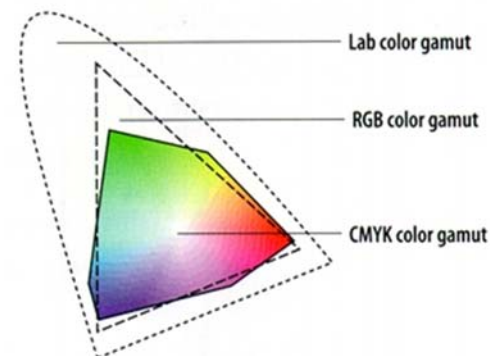
# Color Perception

**Paint** (subtractive)

Illumination

+

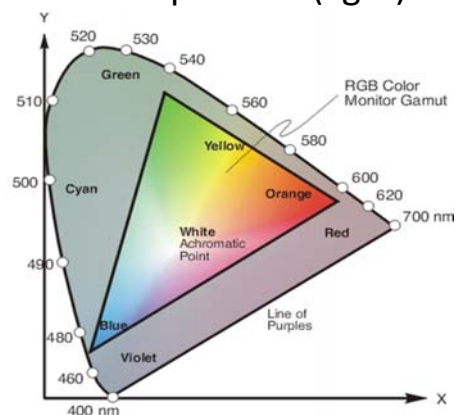
Surface & color of object (paint)



Cone sensitivity of human eye

**Light** (additive mixing)

Color composition (light)



Cone sensitivity of human eye

# Color Perception

**Paint** (subtractive)

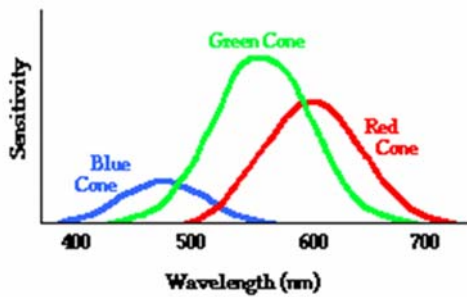
Illumination

+

Surface & color of object (paint)

+

Cone sensitivity of human eye

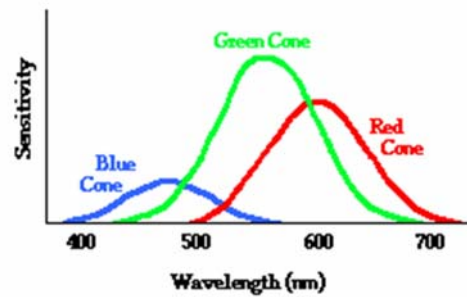


**Light** (additive mixing)

Color composition (light)

+

Cone sensitivity of human eye



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# Example of Subtractive Mixing

Illumination

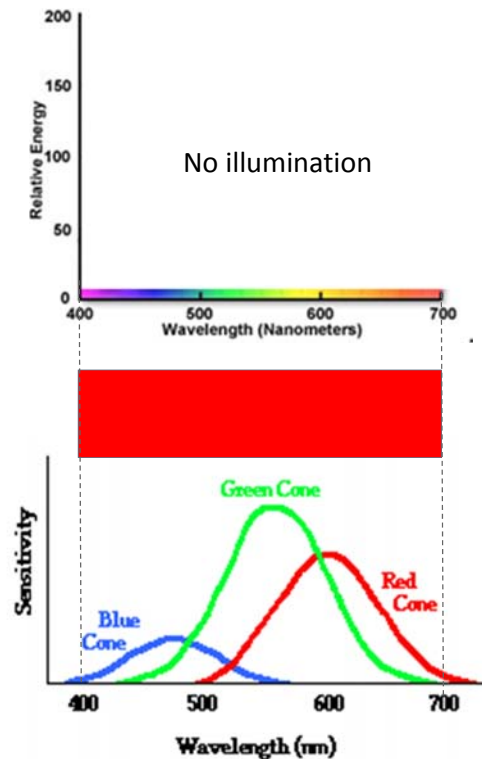
+

Surface & color of object (paint)

+

Cone sensitivity of human eye

= black



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## Example of Subtractive Mixing

Illumination

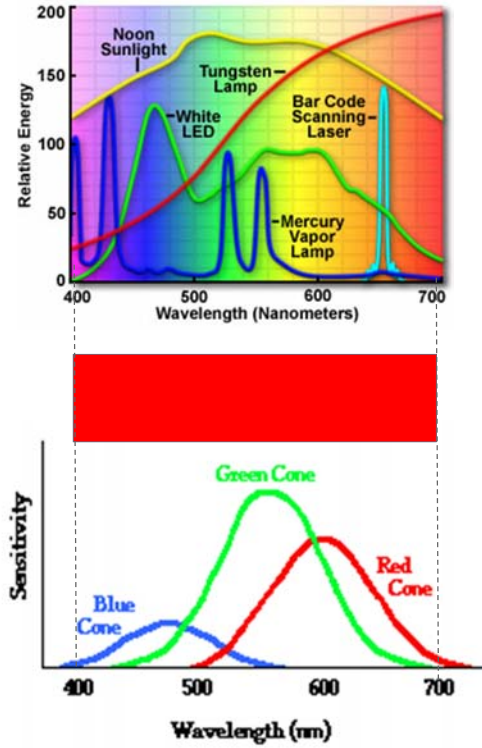
+ sunlight

Surface & color of object (paint)

+

Cone sensitivity of human eye

= red



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## Example of Subtractive Mixing

Illumination

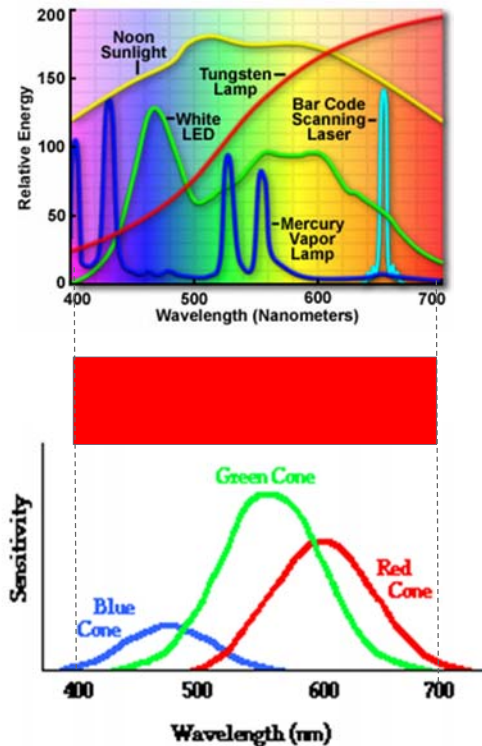
+ Bar code laser

Surface & color of object (paint)

+

Cone sensitivity of human eye

= red



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## Example of Subtractive Mixing

Illumination

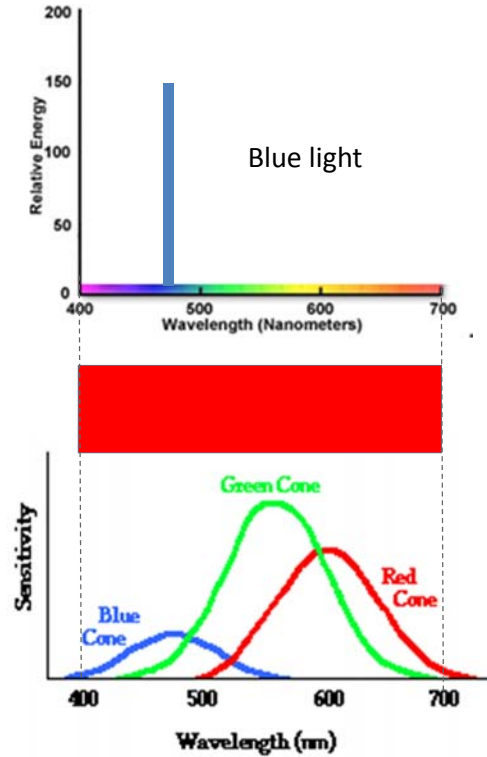
+

Surface & color of object (paint)

+

Cone sensitivity of human eye

= black



00

## Example of Subtractive Mixing

Illumination

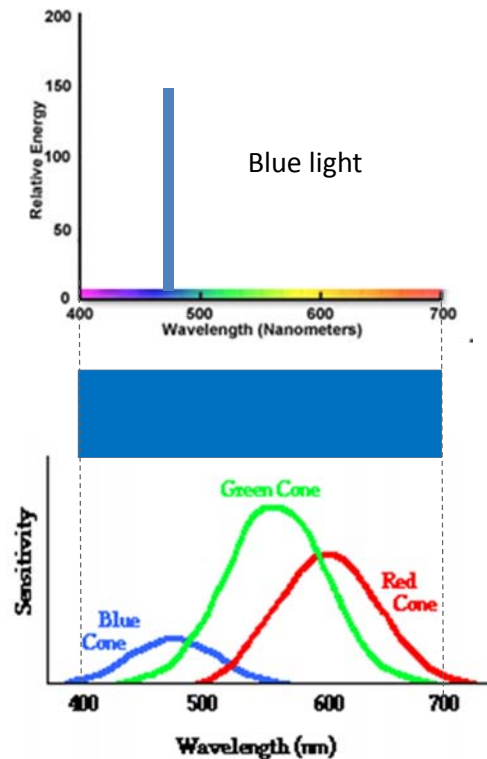
+

Surface & color of object (paint)

+

Cone sensitivity of human eye

= blue



01

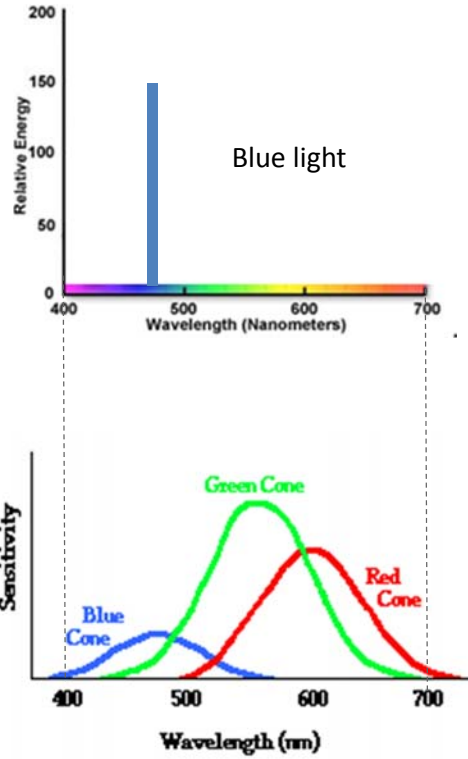
## Example of Additive Mixing

Color composition (light)

+

Cone sensitivity of human eye

= blue



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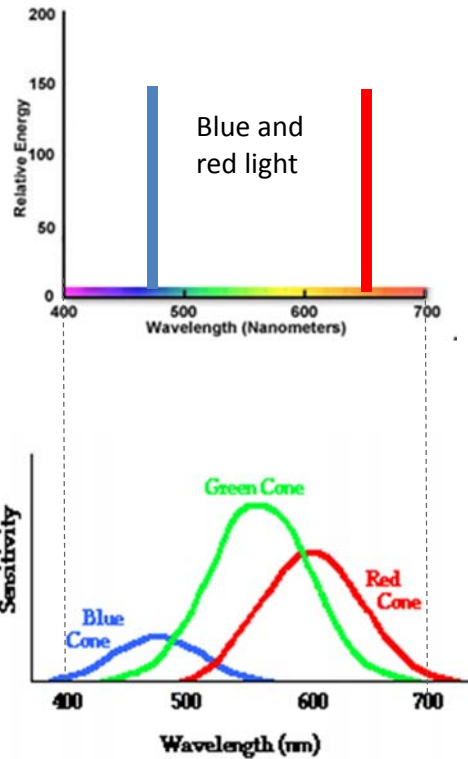
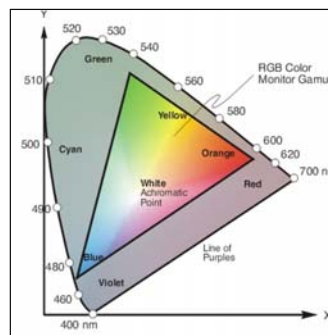
## Example of Additive Mixing

Color composition (light)

+

Cone sensitivity of human eye

= violet



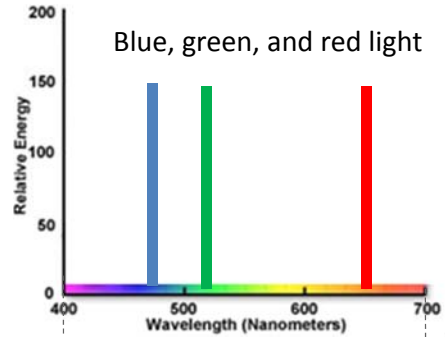
03



## Example of Additive Mixing

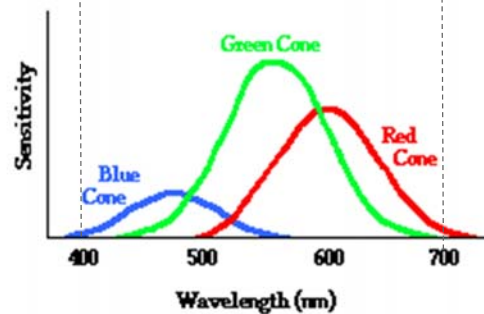
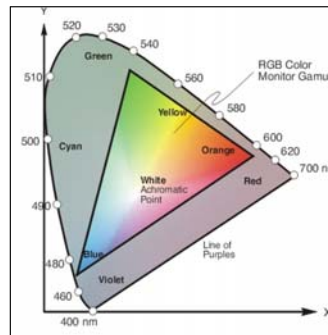
Color composition (light)

+



Cone sensitivity of human eye

= white



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## Color Reproduction

- Reproducing the very same colors across multiple hardware platforms (printers, displays) is critical if color encodes data values.
- Non-emitting surfaces such as paper absorb and reflect the light that hits their surface.
- The type of paper used (coated, uncoated, and matte stock), will affect the appearance of colors, as will paper color.
- Standard matching systems—e.g., the PANTONE MATCHING SYSTEM that ships with Adobe and many other products as well as most printers—are used to ensure color consistency.

<http://www.pantone.com>

# Acknowledgments

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Many visualizations used in the course come from the *Places & Spaces: Mapping Science* exhibit, online at <http://scimaps.org>, and from the *Atlas of Science: Visualizing What We Know*, MIT Press (2010).

