

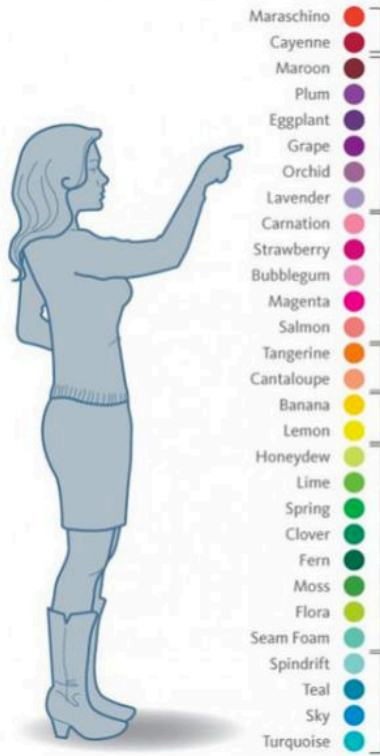


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DATA VISUALIZATION AND VISUAL ANALYTICS

How many color?

Female



Male



Dog



Programmer

- Gray #f94433
- Gray #ac203b
- Gray #85343d
- Gray #874994
- Gray #663c84
- Gray #8c2590
- Gray #a16799
- Gray #af99c7
- Gray #f38da3
- Gray #d2157b
- Gray #ec90b7
- Gray #e90086
- Gray #f57d7e
- Gray #f27727
- Gray #fc9b7b
- Gray #f7d305
- Gray #f1e311
- Gray #ccdf62
- Gray #68bd46
- Gray #0aae4f
- Gray #069665
- Gray #057054
- Gray #3ba246
- Gray #abc37
- Gray #68c3b2
- Gray #8bccd0
- Gray #0687a7
- Gray #078dca
- Gray #0fb8b5

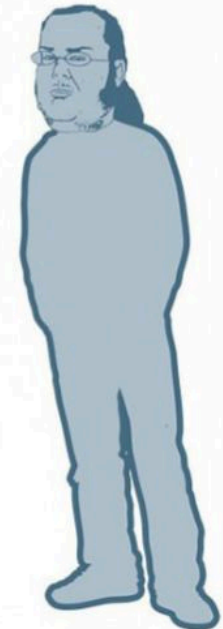


Photo Receptor Cells

- Two types of light sensitive cells
 - **Rod Cells** (~120M)
 - Provide low-light vision
 - Peripheral vision
 - Almost no role in color vision
 - **Cone cells** (~6M)
 - Provide normal vision
 - Three sub-types of cells
 - Sensitivity to different light wavelengths
 - Used for colored vision

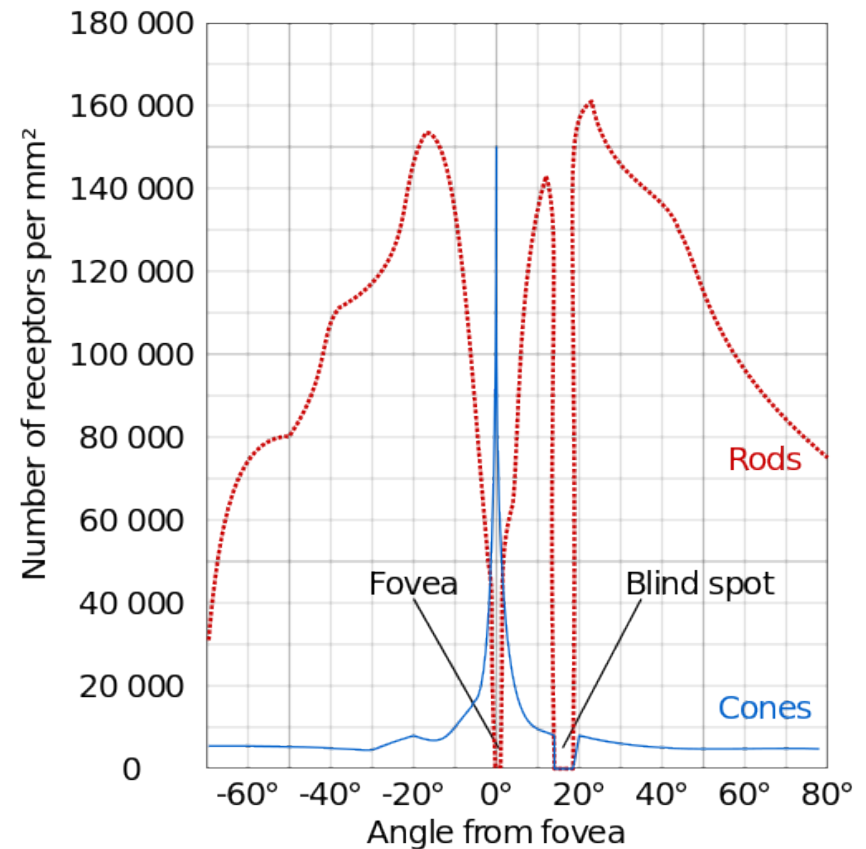
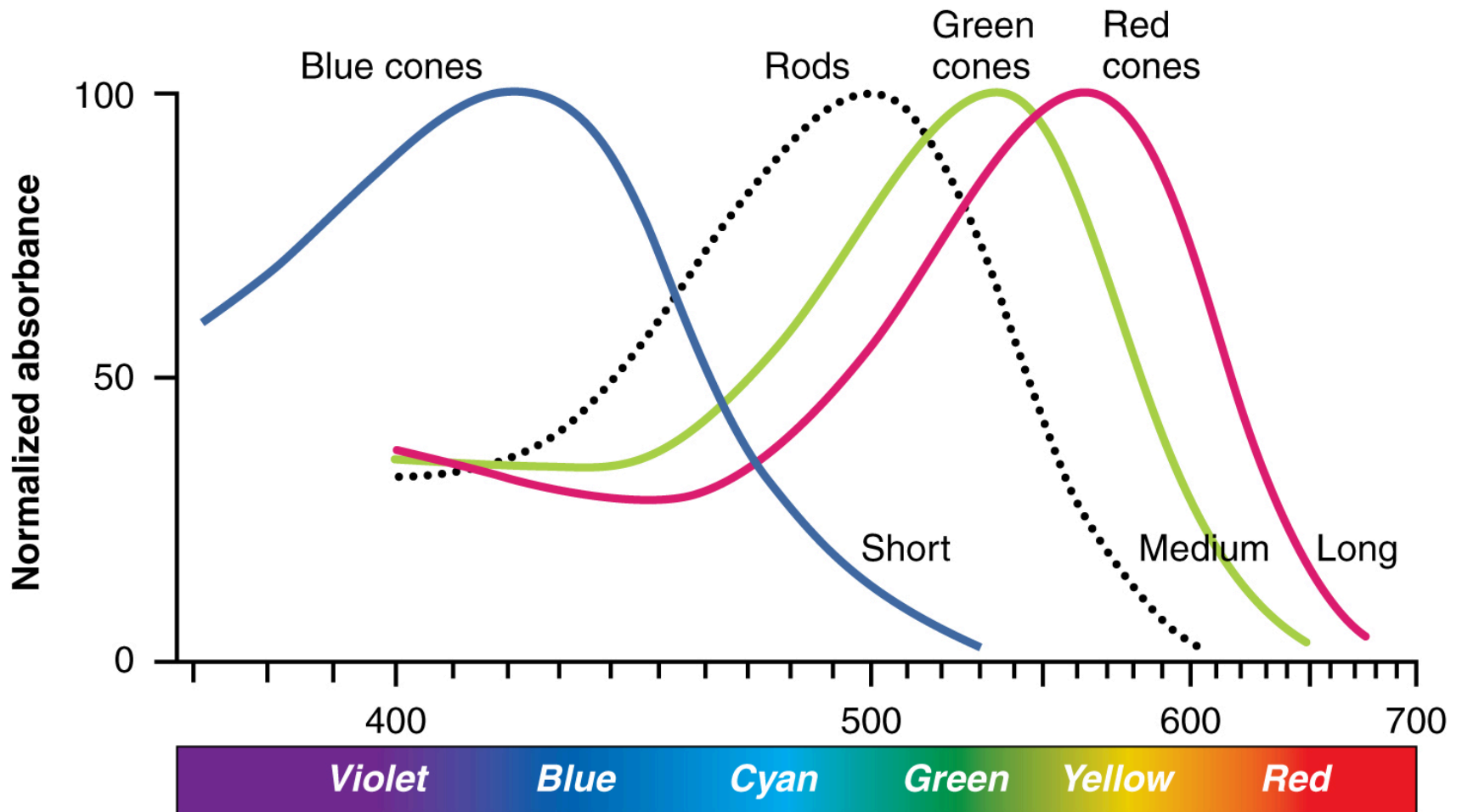


Photo Receptor Cells



Game #6

The image features two large, stylized parentheses, one on the left and one on the right, which serve as brackets for the central text. Each parenthesis is composed of multiple overlapping, semi-transparent curved bands. The left parenthesis has a rainbow gradient from yellow at the top to blue at the bottom. The right parenthesis has a rainbow gradient from yellow at the top to purple at the bottom. In the lower right portion of the right parenthesis, there is a small, solid black circle.

color

click to get started

<http://color.method.ac>

Color of the Year: 2016

COLOR FORMULA & GUIDES

PANTONE Color of the Year 2016 can be found in the following color systems:

ROSE QUARTZ

FASHION + HOME PANTONE 13-1520TCX

RGB for TCX

sR	sG	sB
247	202	201

CMYK for TCX

C	M	Y	K
0	24	15	0

HTML Values for TCX: F7CAC9

PANTONE Pastel 9281 C (Closest Match)


9281 C RGB

sR	sG	sB
242	221	222

CMYK for 9281 C

C	M	Y	K
0	14	9	0

HTML Values for 9281 C: F2DDDE

 Get Rose Quartz & Serenity and color pairings in [ASE file format](#) for Adobe® Applications.

Plastic

PQ-13-1520TCX

SERENITY

FASHION + HOME PANTONE 15-3919TCX

RGB for TCX

sR	sG	sB
146	168	209

CMYK for TCX

C	M	Y	K
42	24	3	0

HTML Values for TCX: 92A8D1

PLUS Series 7451 C (Closest Match)


Plus Series RGB

sR	sG	sB
137	171	227

Plus Series CMYK

C	M	Y	K
46	23	0	0

HTML Values for Plus Series: 89ABE3

 Download Rose Quartz and Serenity wallpaper for your mobile device or desktop.

Plastic

PQ-15-3919TCX

Color of the year 2017

COLOR FORMULAS, GUIDES & STANDARDS



COLOR FORMULA & GUIDES

PANTONE Color of the Year 2017 can be found in the following color systems:

GREENERY

FASHION + HOME PANTONE 15-0343 TCX				
RGB for TCX	sR	sG	sB	
	136	176	75	
CMYK for TCX	C	M	Y	K
	51	9	88	0
HTML Values for TCX: 88B04B				

PANTONE 376 C (Closest Match)				
PLUS Series RGB	sR	sG	sB	
	132	189	0	
PLUS Series CMYK	C	M	Y	K
	54	0	100	0
HTML Values for PLUS Series: 84BD00				

↓ Get Greenery in [ASE file format for Adobe® Applications.](#)

Plastic
PQ-15-0343 TCX

Color of the year 2019



INTRODUZIONE | STRUMENTI PER DESIGNER | PALETTE DI COLORI | ACQUISTA PANTONE LIVING CORAL | PARTNERS

Color Formula & Guides

Il Pantone Color of the Year 2019 è disponibile nei seguenti sistemi cromatici:

FASHION, HOME + INTERIORS (cotone)
PANTONE 16-1546 LIVING CORAL TCX

Simulazione CMYK per
PANTONE 16-1546 TCX*:

C	M	Y	K
0	65	54	0

Simulazione sRGB con
l'indicatore di luminosità D65
per il PANTONE 16-1546 TCX:

sR	sG	sB
255	111	97

HTML per il PANTONE 16-1546 TCX: **FF6F61**

PLUS SERIES (inchiostro)
PANTONE 2345 C

Simulazione CMYK per
PANTONE 2345 C*:

C	M	Y	K
0	59	50	0


Simulazione sRGB con
l'indicatore di luminosità D65
per il PANTONE 2345 C:

sR	sG	sB
255	109	112

HTML per il PANTONE 2345 C: **FF6D70**

FASHION, HOME + INTERIORS (plastica)
PQ-16-1546TCX

FASHION, HOME + INTERIORS (METALLIC
SHIMMERS)
PANTONE 20-0056 TPM Coralessence

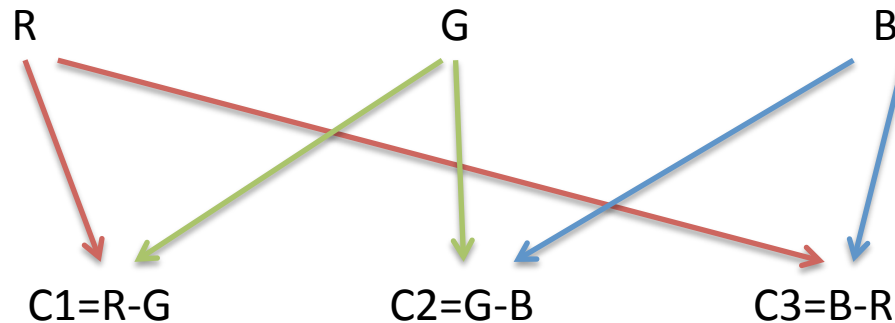
 Procuratevi Living Coral nel formato file
ASE per le applicazioni Adobe.

Color Model

- Young-Helmoltz Theory (19th century)
 - Separate Red, Green, Blue receptors
 - Actually, three receptors type exist
 - Red and Green are located mainly in green-yellow zone
 - Sometimes named as Long, Medium, Short wavelength receptors
 - Eye present different proportions of R,G,B receptors (40:20:1)

Opponent Color Theory

- Based on estimation of opposite readings
 - red-green comparison
 - blue-yellow comparison
 - dark-light comparison



$$C1+C2+C3=0$$

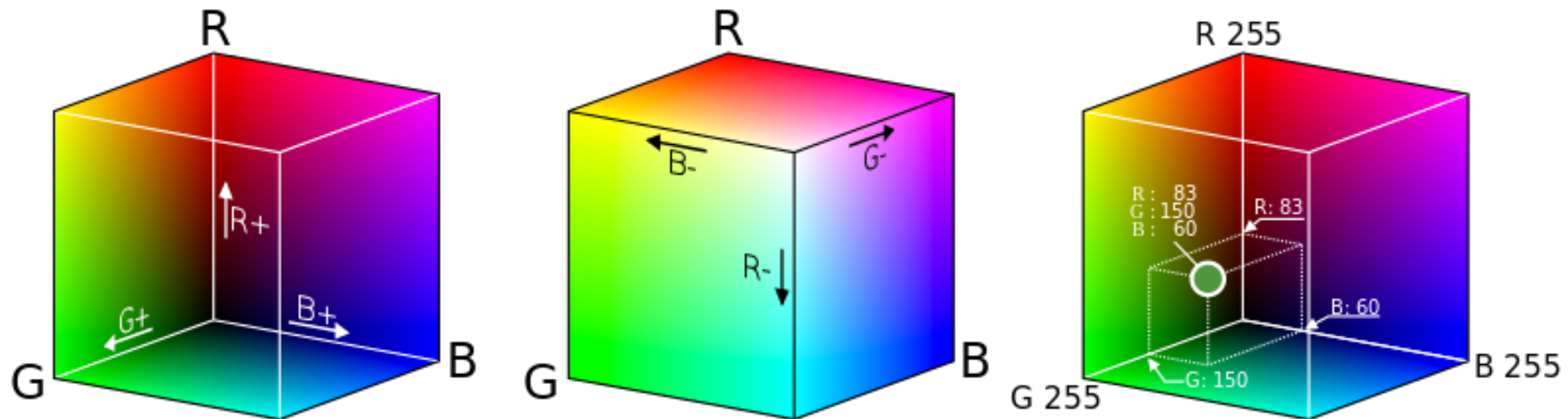
$$C1=R-G$$

$$C3-C2=B-R-G+B=2B-(R+G)$$

$$A = 2R+G+B/20$$

RGB Color Model

- Based on direct specification of three primary colors
- Additive model, each component is summed with the others

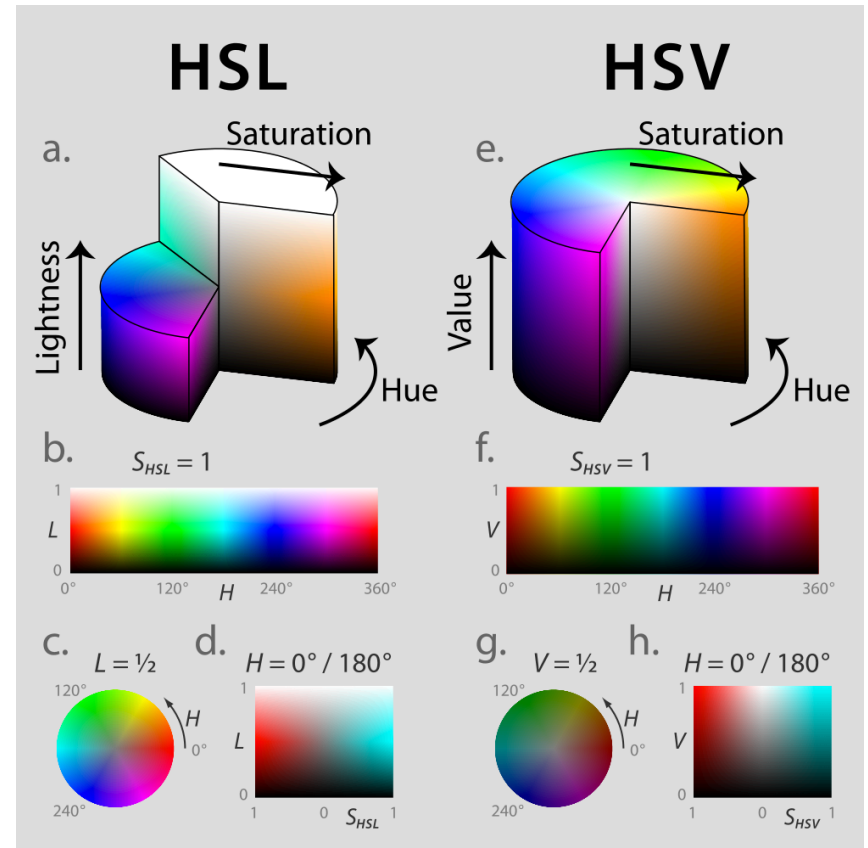


RGB Color Model

- R,G,B values may be expressed in range [0,1]
- Some applications use the range[0,255]
- Usually a hexadecimal notation is used for range [0,ff]
- Not really intuitive: how to define brown?

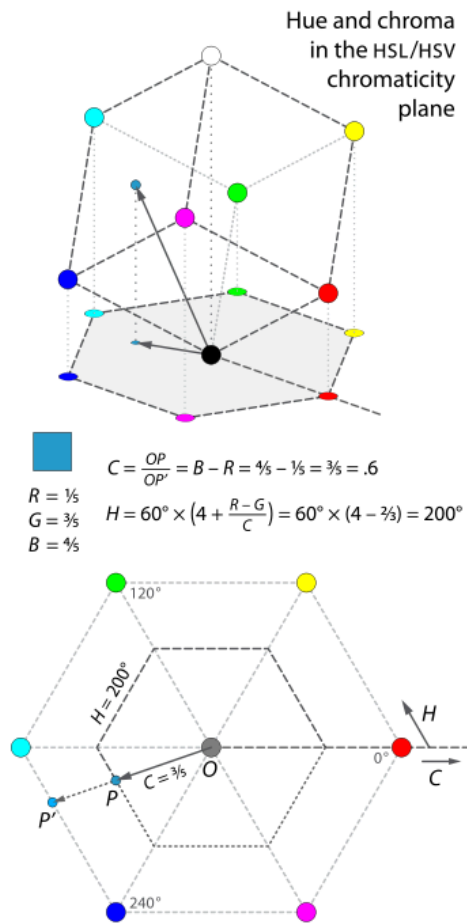
HSV Color Model

- Based on the intuitive concepts of
 - Hue
 - Saturation
 - Value
- Component values are expressed in ranges $[0,1]$ or $[0,255]$

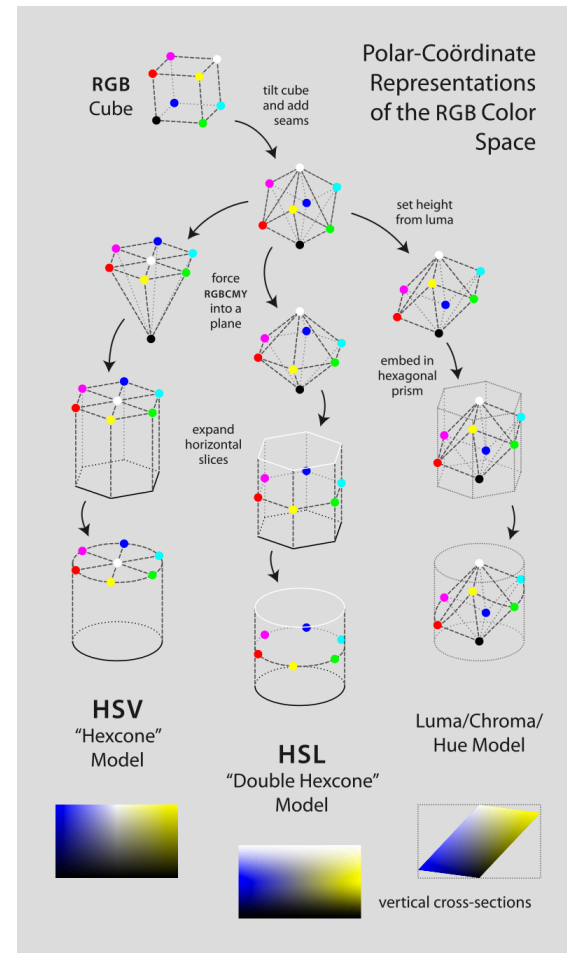


"Hsl-hsv models" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Hsl-hsv_models.svg#/media/File:Hsl-hsv_models.svg

RGB and HSV



"HSL-HSV hue and chroma" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:HSL-HSV_hue_and_chroma.svg#/media/File:HSL-HSV_hue_and_chroma.svg



"Hsl-and-hsv" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - <http://commons.wikimedia.org/wiki/File:Hsl-and-hsv.svg#/media/File:Hsl-and-hsv.svg>

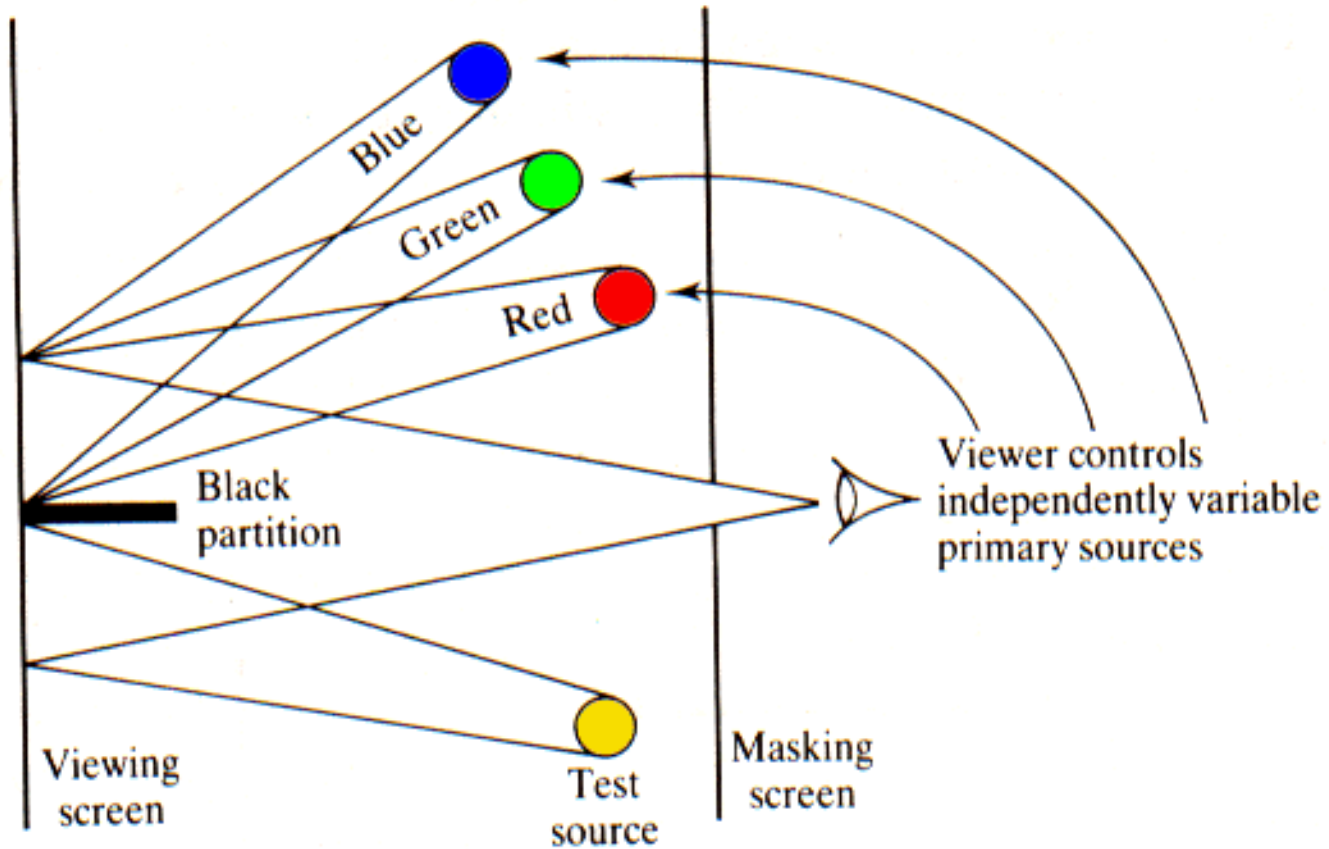


COLOURIMETRY

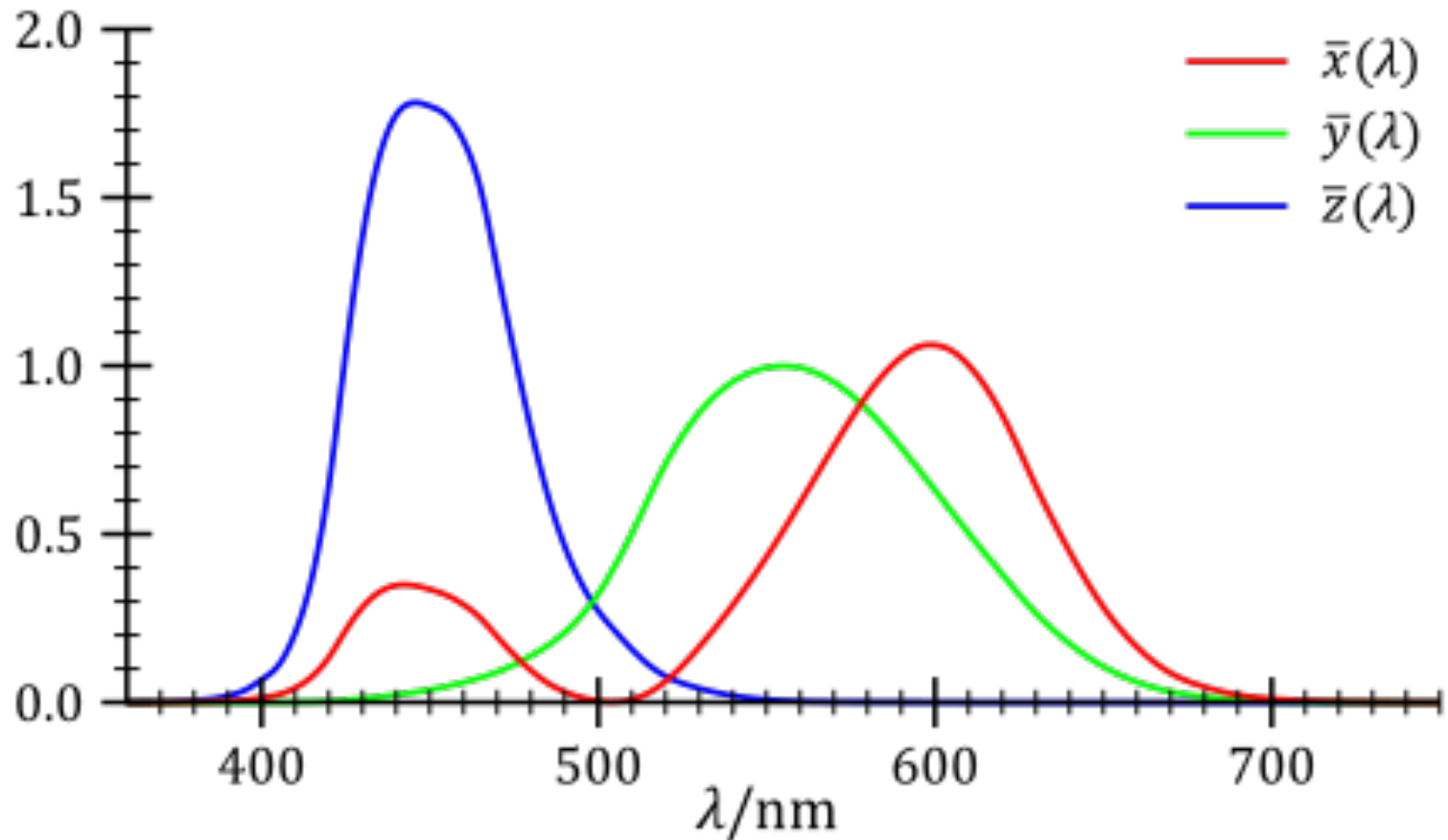
CIE Standard Observer

- CIE: International Commission on Illumination
- Definition of an objective color-mapping function:
 - Standard colorimetric observer
- Experiment
 - An observer is positioned in front of a bipartite screen
 - Observer can manipulate intensities of three primary color beams
 - Task: match the reference color

Standard Observer Experiment

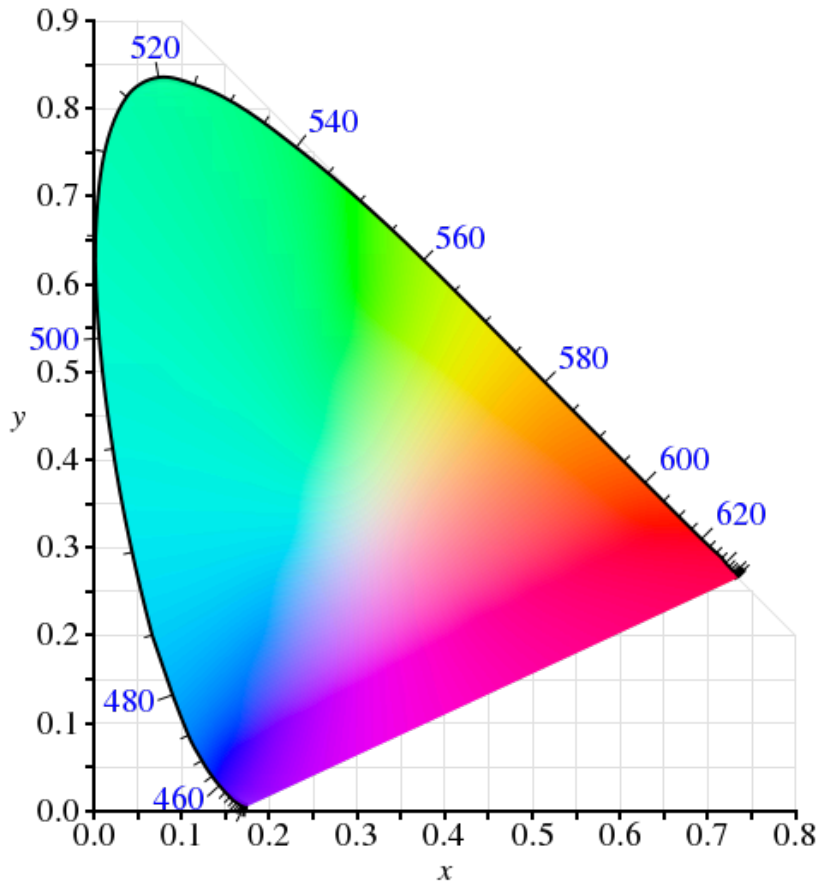


Color Matching Functions: imaginary primary colors



"CIE 1931 XYZ Color Matching Functions" by User:Acxd - Own work. Licensed under GFDL via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:CIE_1931_XYZ_Color_Matching_Functions.svg#/media/File:CIE_1931_XYZ_Color_Matching_Functions.svg

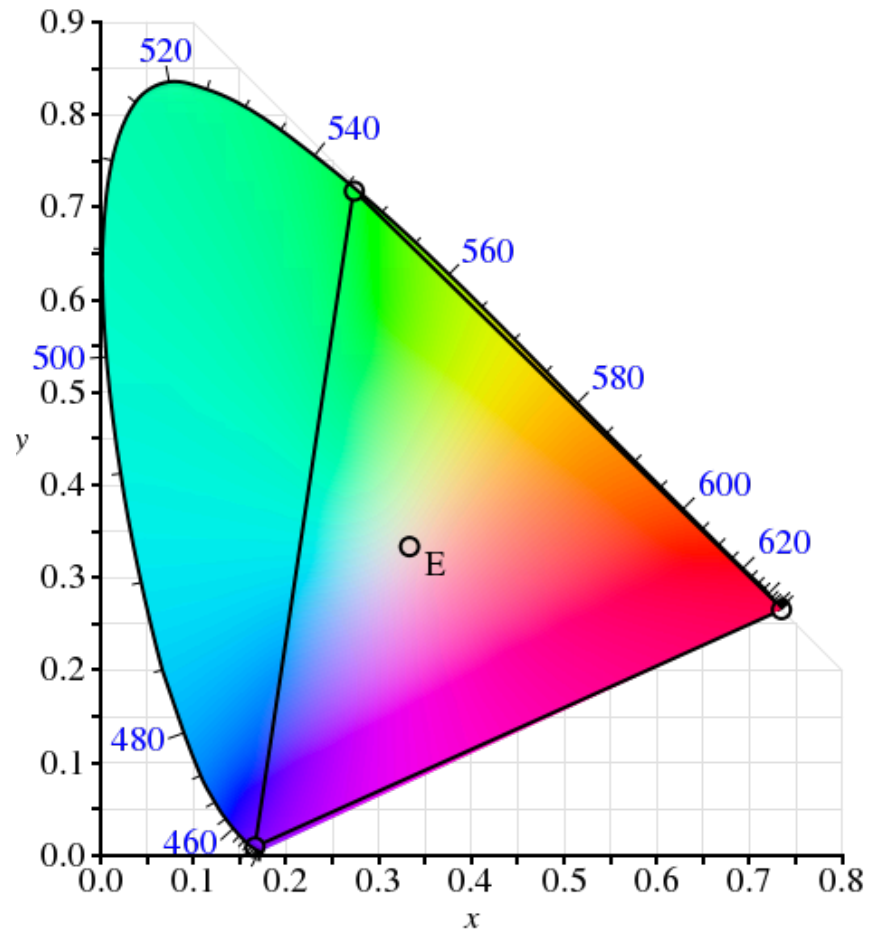
Chromaticity Diagram



- A mixture of two colors lies on the line connecting the two colors
- Chromaticity Diagram (**gamut**) is convex
- All visible colors are non-negative combination of x , y , and z
- An equal combination of two colors does not lie in the mid-point

Color Mixing

- Given three primary colors, the corresponding triangle cannot cover the whole gamut



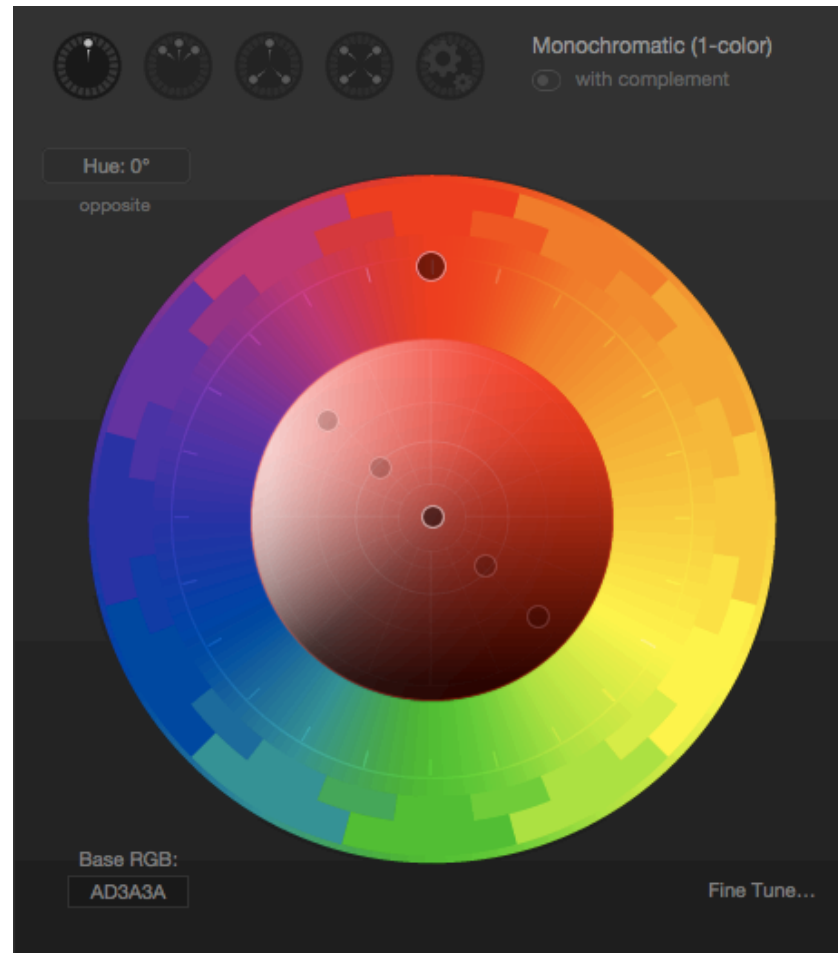
"CIE1931xy CIERGB" by BenRG - Own work, inspired by
File:CIExy1931.png. Licensed under Public Domain via Wikimedia
Commons - [http://commons.wikimedia.org/wiki/
File:CIE1931xy_CIERGB.svg#/media/File:CIE1931xy_CIERGB.svg](http://commons.wikimedia.org/wiki/File:CIE1931xy_CIERGB.svg#/media/File:CIE1931xy_CIERGB.svg)



PALETTE

Color Schemes

Cold colors



Warm colors

<http://paletton.com/>

Color Schemes for Cartography

The screenshot displays the ColorBrewer 2.0 web interface. At the top right, the logo reads "COLORBREWER 2.0" with the tagline "color advice for cartography". Navigation links for "how to use", "updates", "downloads", and "credits" are visible. The main interface is divided into several control panels on the left and a large map area on the right.

Number of data classes: 3

Nature of your data: sequential diverging qualitative

Pick a color scheme: A grid of 12 color scheme thumbnails is shown.

Only show: colorblind safe print friendly photocopy safe

Context: roads cities borders

Background: solid color terrain

3-class Set1

EXPORT

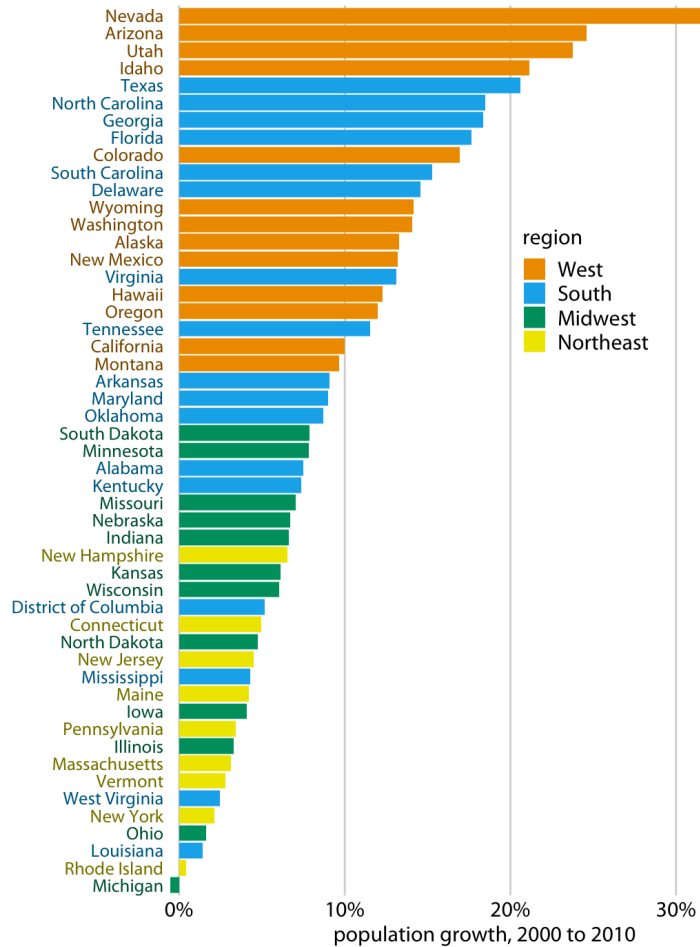
HEX

- #e41a1c
- #377eb8
- #4daf4a

The map area shows a geographical region divided into numerous small polygons, each colored according to the selected 3-class qualitative scheme (red, blue, and green). The colors are distributed across the map, with red occupying the left side, blue in the center, and green on the right.

<http://colorbrewer2.org/>

Color scheme example (nominal)



Okabe Ito



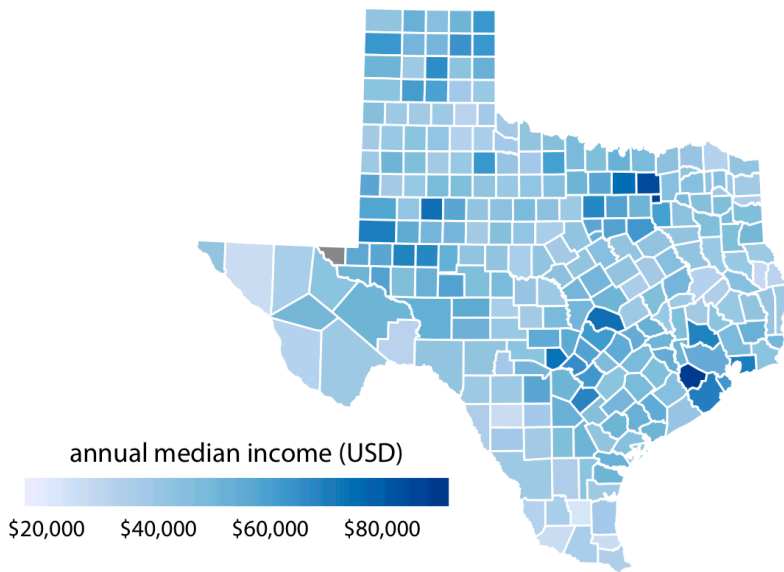
ColorBrewer Dark2



ggplot2 hue



Color scheme example (sequential)



ColorBrewer Blues



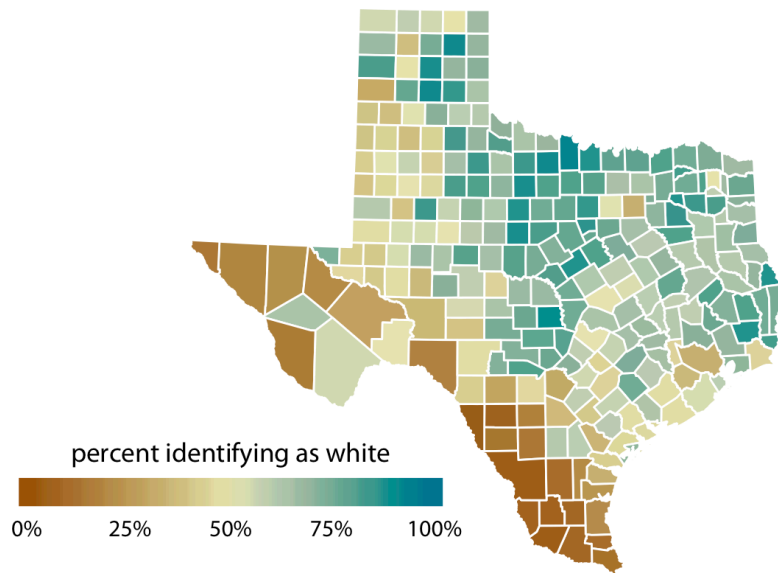
Heat



Viridis



Color scheme example (divergent)



CARTO Earth



ColorBrewer PiYG



Blue-Red



Takeaway Messages

- Different color models and encodings
- Color palettes to represent scales of values