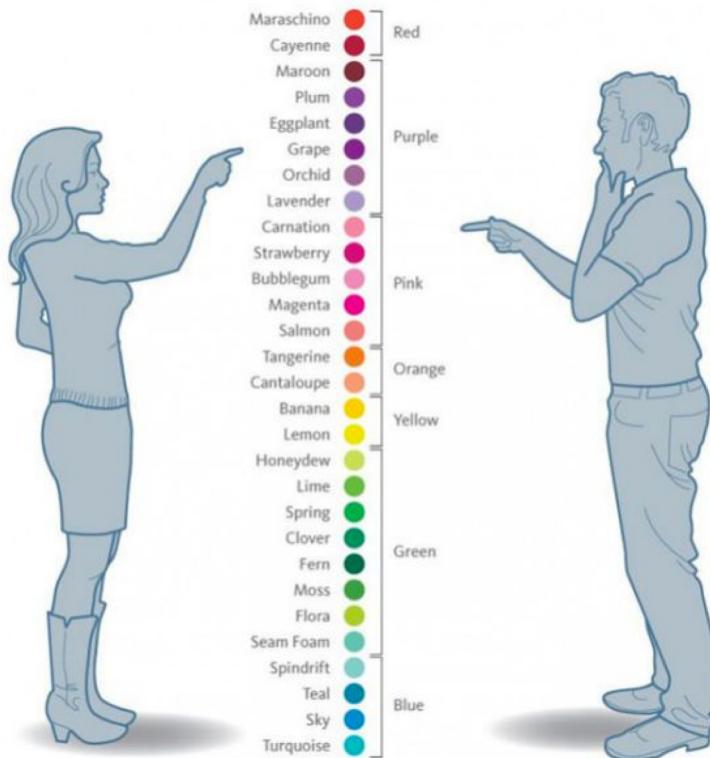


S. Rinzivillo – rinzivillo@isti.cnr.it

DATA VISUALIZATION AND VISUAL ANALYTICS

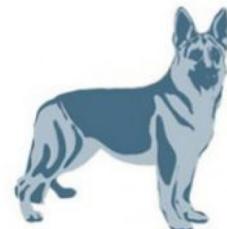
How many color?

Female



Male

Dog



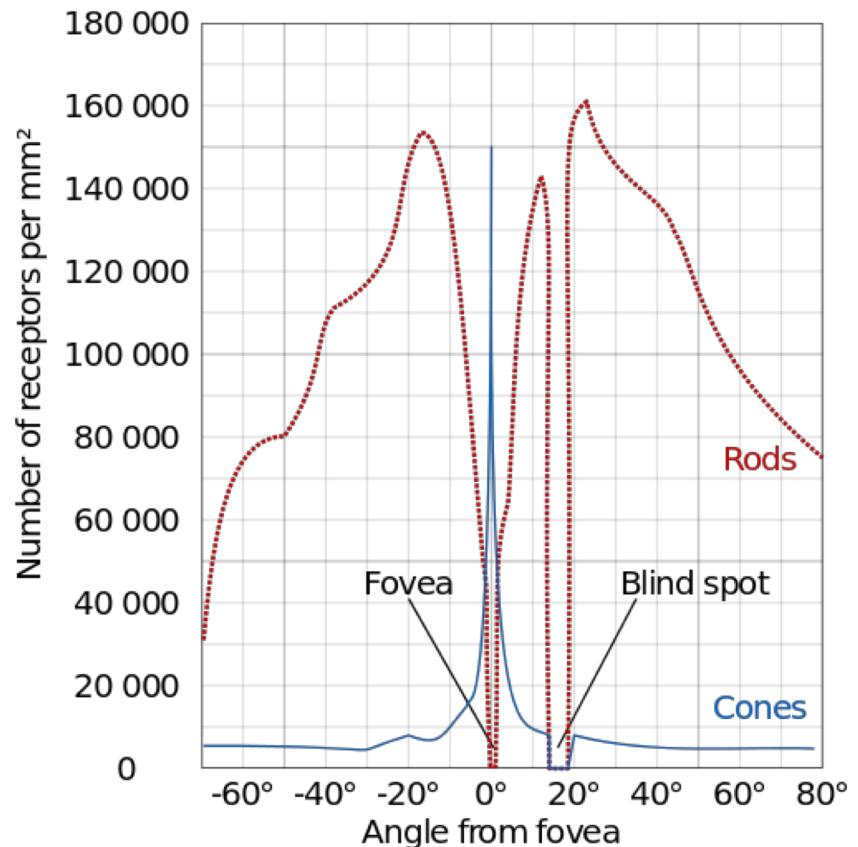
Programmer

Gray (#f94433)
Gray (#ac203b)
Gray (#85343d)
Gray (#874994)
Gray (#663c84)
Gray (#8c2590)
Gray (#a16799)
Gray (#af99c7)
Gray (#38da3)
Gray (#d2157b)
Gray (#ec90b7)
Gray (#e90086)
Gray (#f57d7e)
Gray (#27727)
Gray (#fc9b7b)
Gray (#f7d305)
Gray (#1e311)
Gray (#ccdf62)
Gray (#68bd46)
Gray (#0aae4f)
Gray (#069665)
Gray (#057054)
Gray (#3ba246)
Gray (#abcf37)
Gray (#68c3b2)
Gray (#8bccd0)
Gray (#0687a7)
Gray (#078dca)
Gray (#0fb8b5)



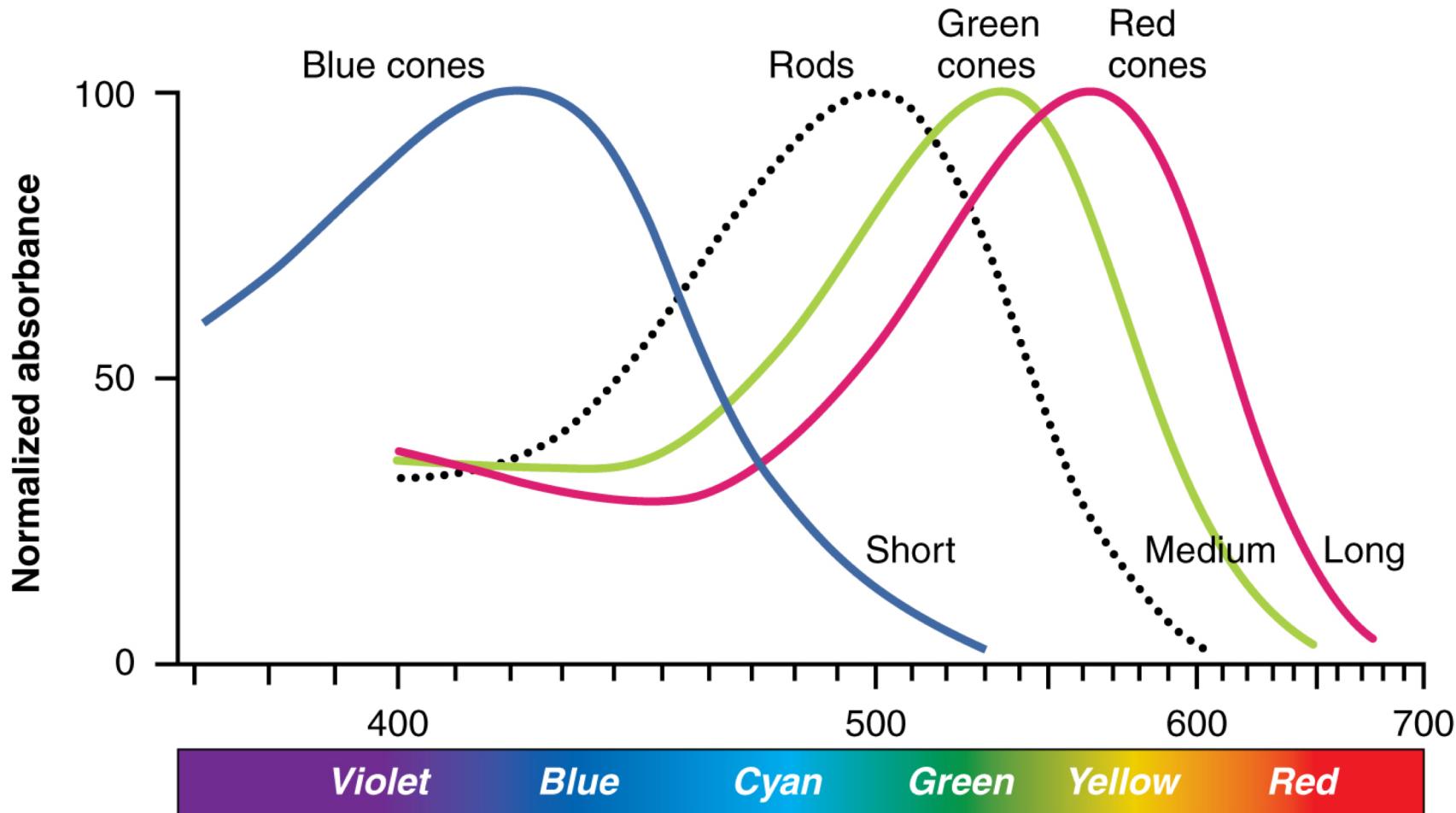
Photo Receptor Cells

- 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



"Human photoreceptor distribution" by Cmglee - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Human_photoreceptor_distribution.svg#mediaviewer/File:Human_photoreceptor_distribution.svg

Photo Receptor Cells



"1416 Color Sensitivity" by OpenStax College - Anatomy & Physiology, Connexions Web site. <http://cnx.org/content/col11496/1.6/>, Jun 19, 2013..

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http://commons.wikimedia.org/wiki/File:1416_Color_Sensitivity.jpg#mediaviewer/File:1416_Color_Sensitivity.jpg

Game #6



color

click to get started

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
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
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



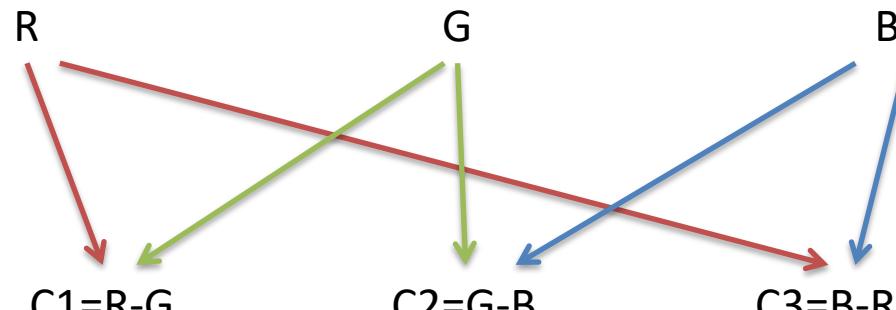
Procuratevi Living Coral nel formato file ASE per le applicazioni Adobe.

Color Model

- Young-Helmotz 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



$$C_1 + C_2 + C_3 = 0$$

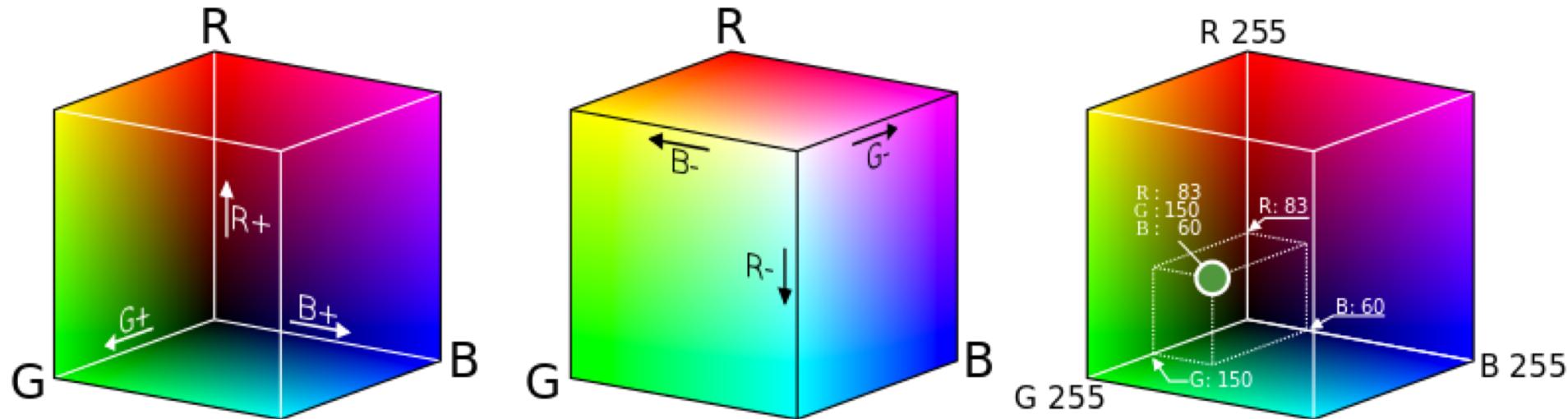
$$C_1 = R - G$$

$$C_3 - C_2 = B - R - G + B = 2B - (R + G)$$

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

RGB Color Model

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

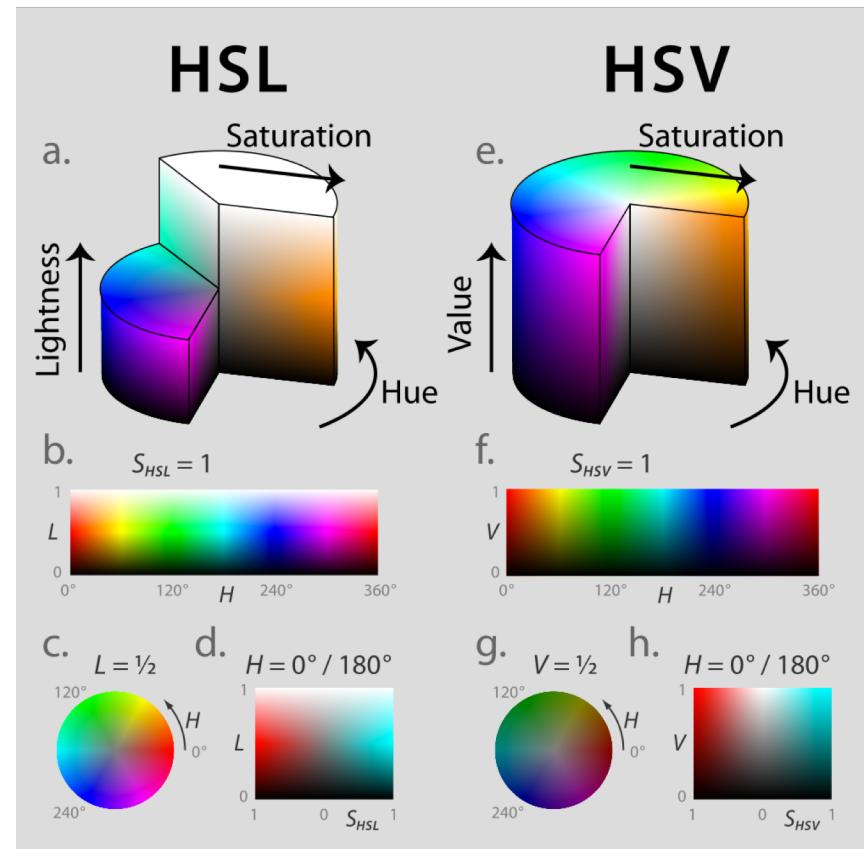


RGB Color Model

- 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?

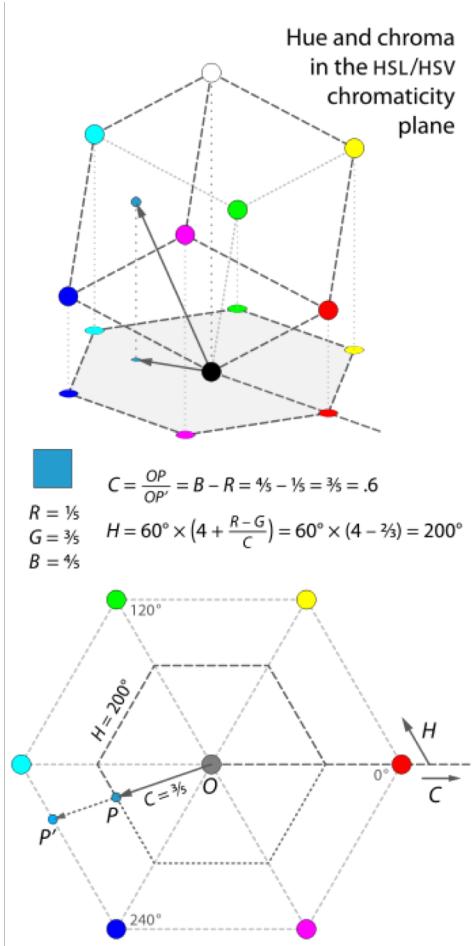
HSV Color Model

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

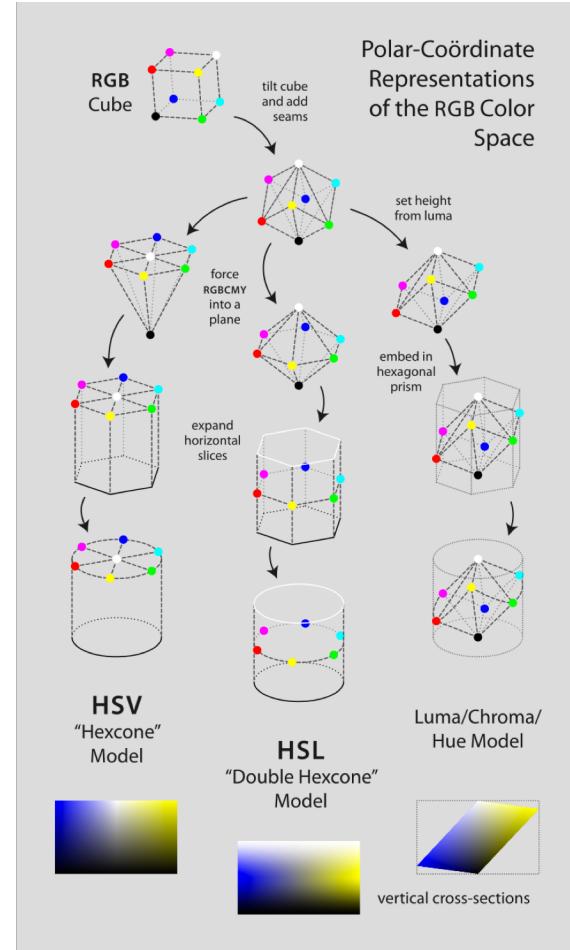


"Hsl-hsv models" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Hsl-hsv_models.svg#/media/File:Hsl-hsv_models.svg

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



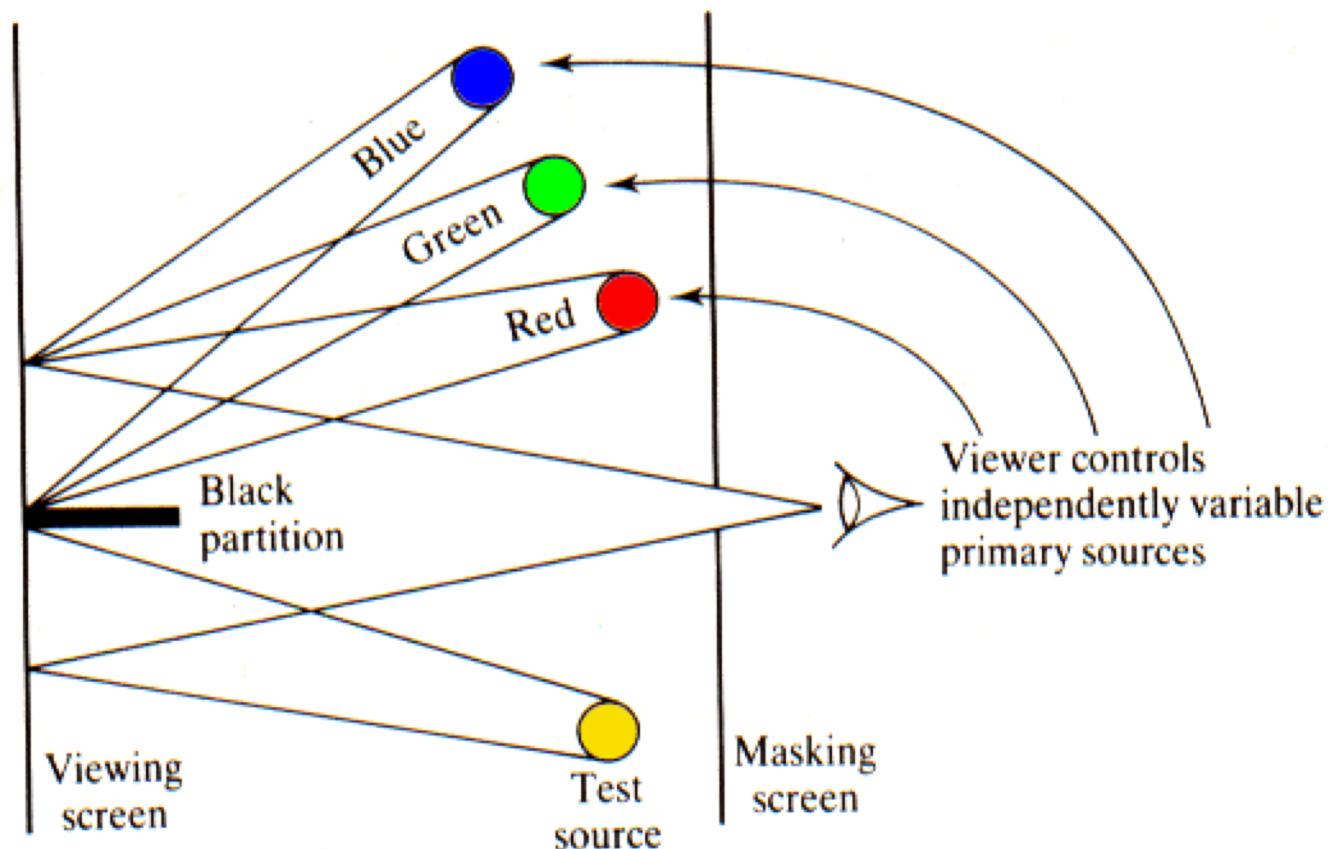
"Hsl-and-hsv" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - <http://commons.wikimedia.org/wiki/File:Hsl-and-hsv.svg#media/File:Hsl-and-hsv.svg>

COLOURIMETRY

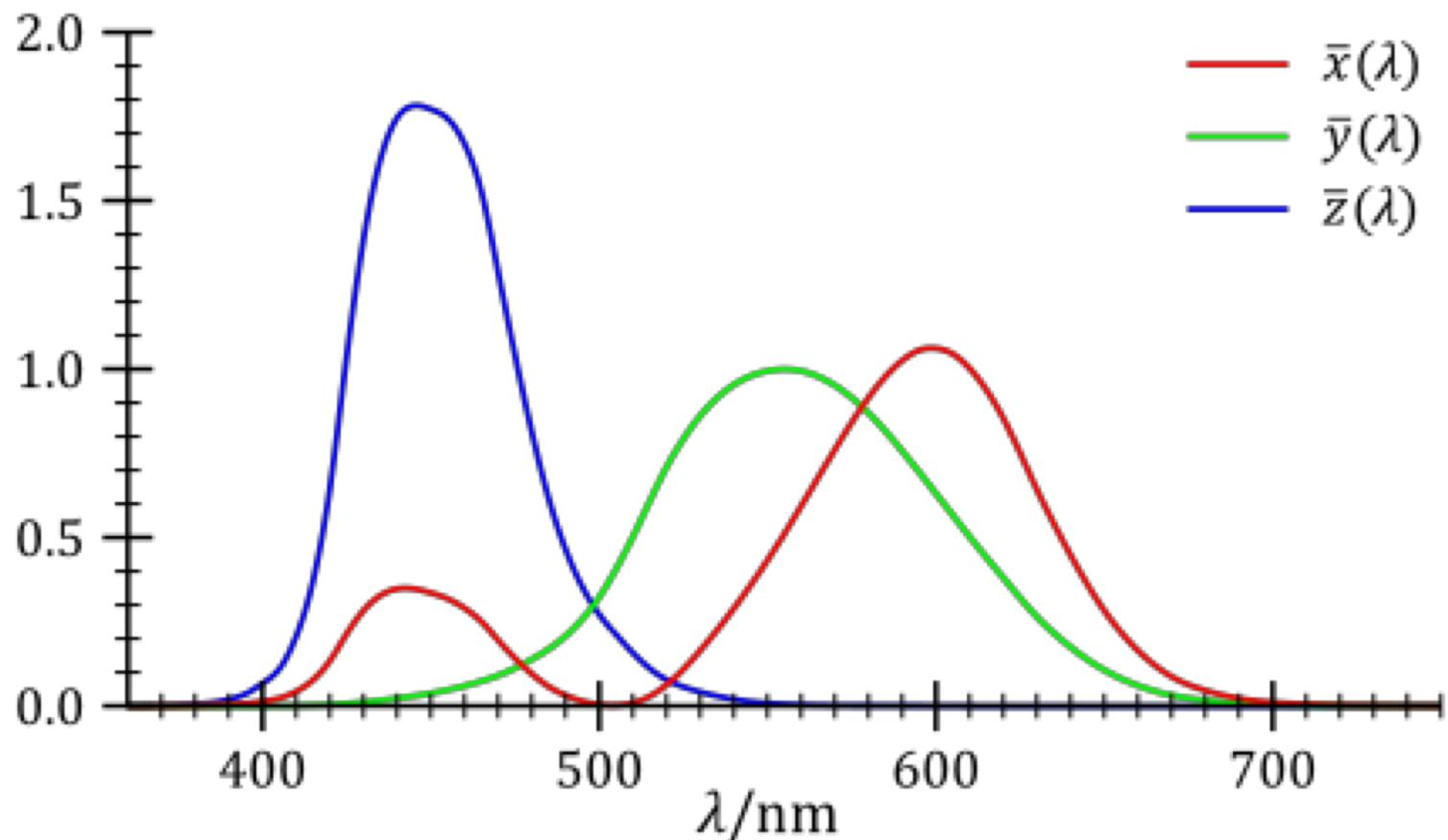
CIE Standard Observer

- 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

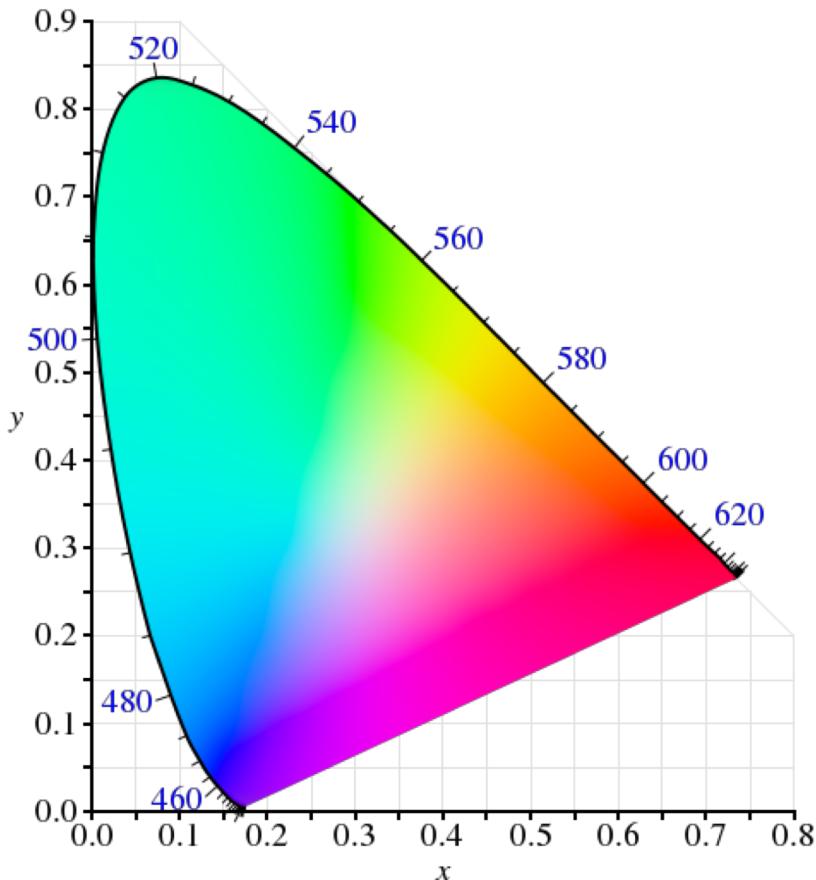


Color Matching Functions: imaginary primary colors



"CIE 1931 XYZ Color Matching Functions" by User:Acdx - 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

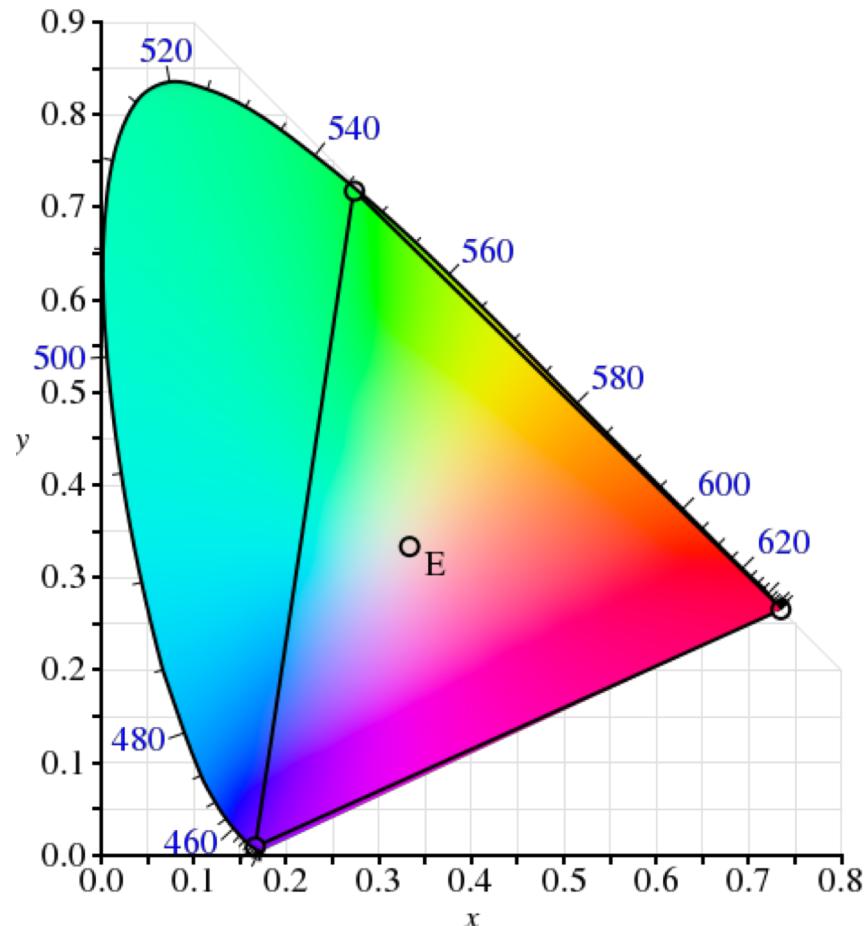


- A mixture of two colors lies on the line connecting the two colors
- Chromaticity Diagram (**gamut**) is convex
- All visible colors are non-negative combination of x, y, and z
- An equal combination of two colors does not lie in the mid-point

"CIE1931xy blank" by BenRG - File:CIExy1931.svg. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:CIE1931xy_blank.svg#/media/File:CIE1931xy_blank.svg

Color Mixing

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



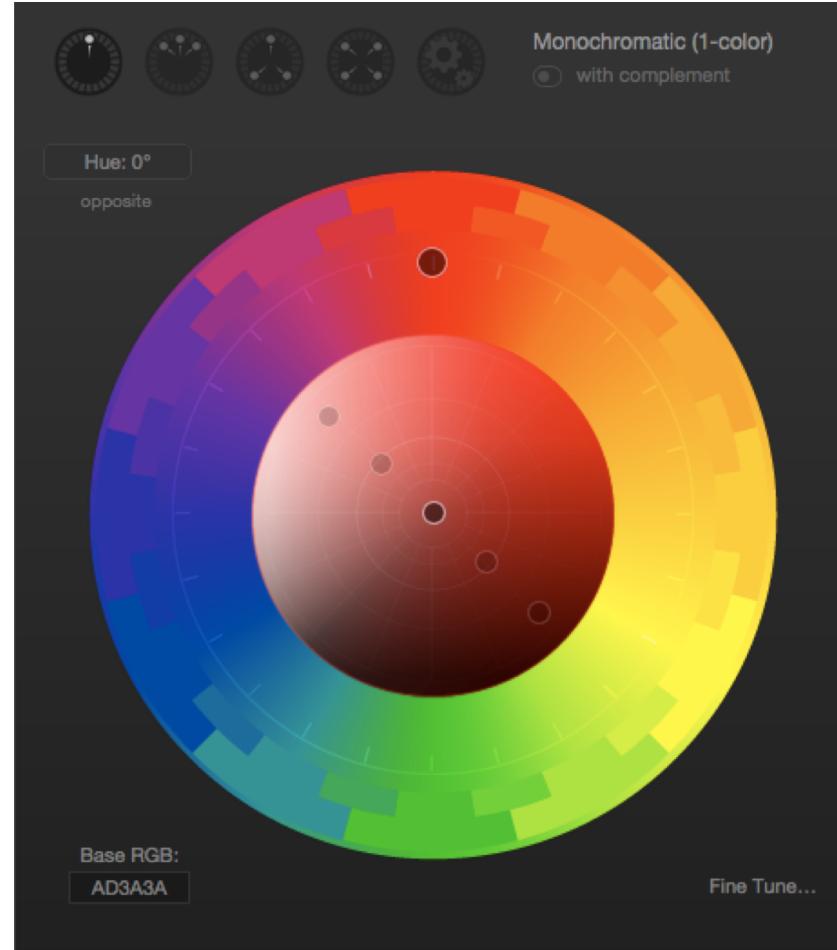
"CIE1931xy_CIERGB" by BenRG - Own work, inspired by File:CIExy1931.png. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:CIE1931xy_CIERGB.svg#/media/



PALETTE

Color Schemes

Cold colors



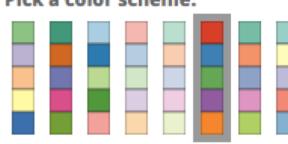
Warm colors

Color Schemes for Cartography

Number of data classes: 3

Nature of your data:
 sequential diverging qualitative

Pick a color scheme:



Only show:
 colorblind safe
 print friendly
 photocopy safe

Context:
 roads
 cities
 borders

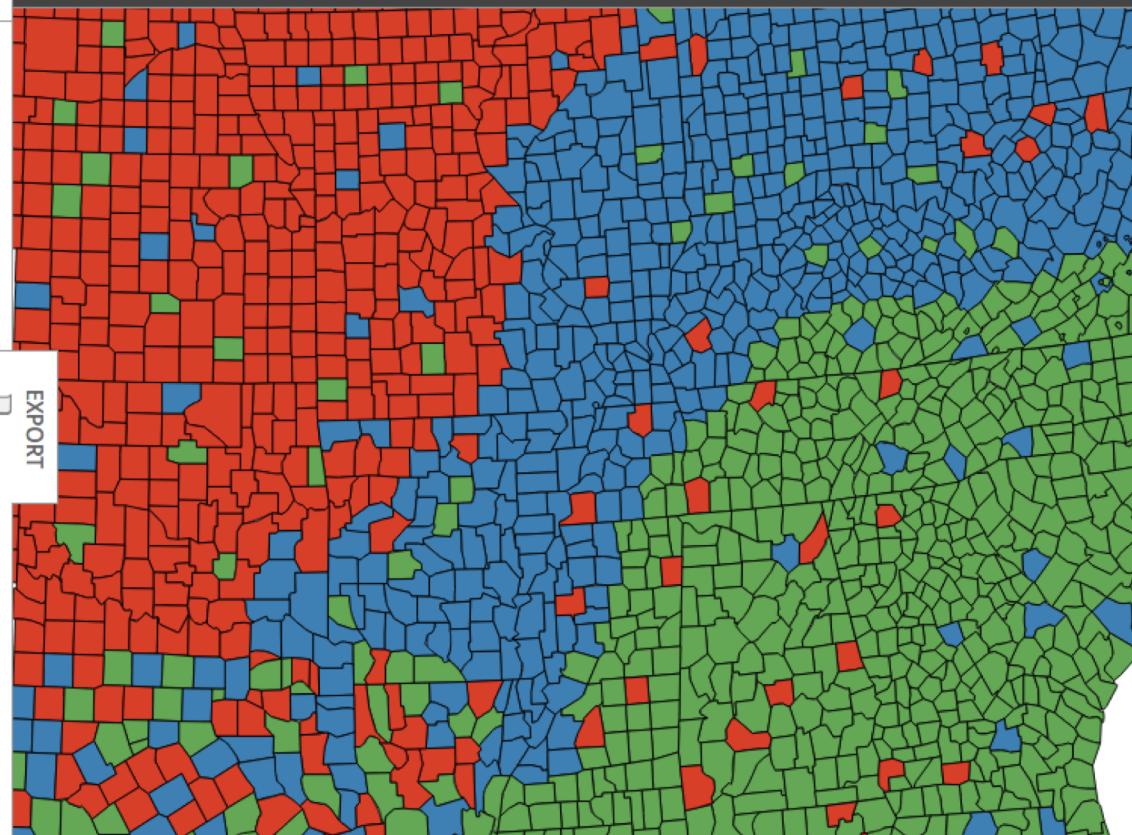
Background:
 solid color
 terrain

color transparency

how to use | updates | downloads | credits

COLORBREWER 2.0
color advice for cartography

3-class Set1



EXPORT

HEX

#e41a1c
#377eb8
#4daf4a

<http://colorbrewer2.org/>

Takeaway Messages

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