

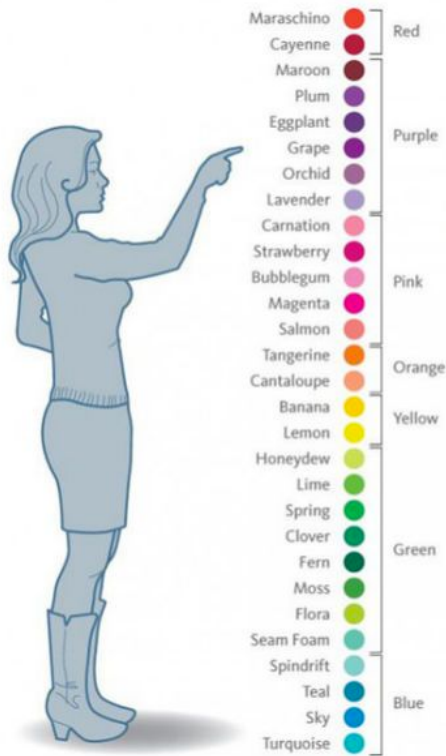


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DATA VISUALIZATION AND VISUAL ANALYTICS

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 #abcf37
Gray #68c3b2
Gray #8bccd0
Gray #0687a7
Gray #078dca
Gray #0fb8b5

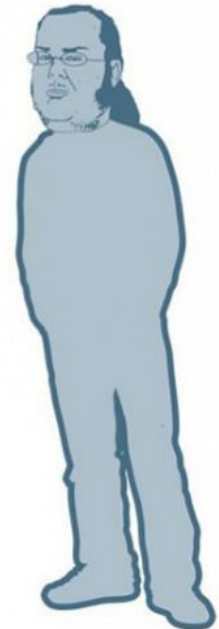


Photo Receptor Cells

- 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

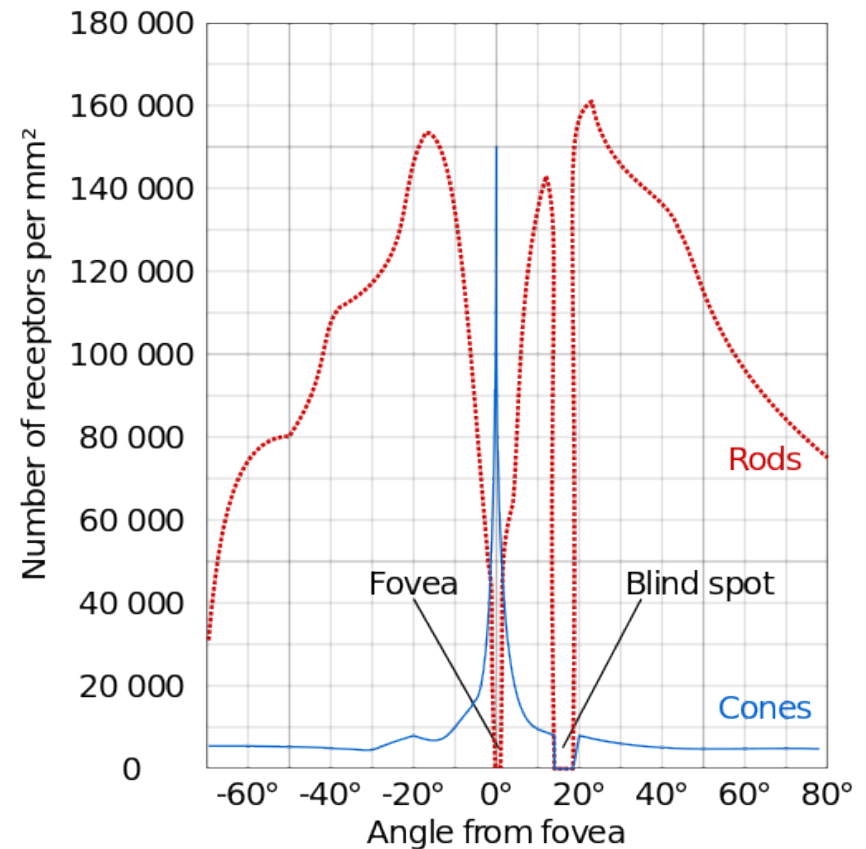
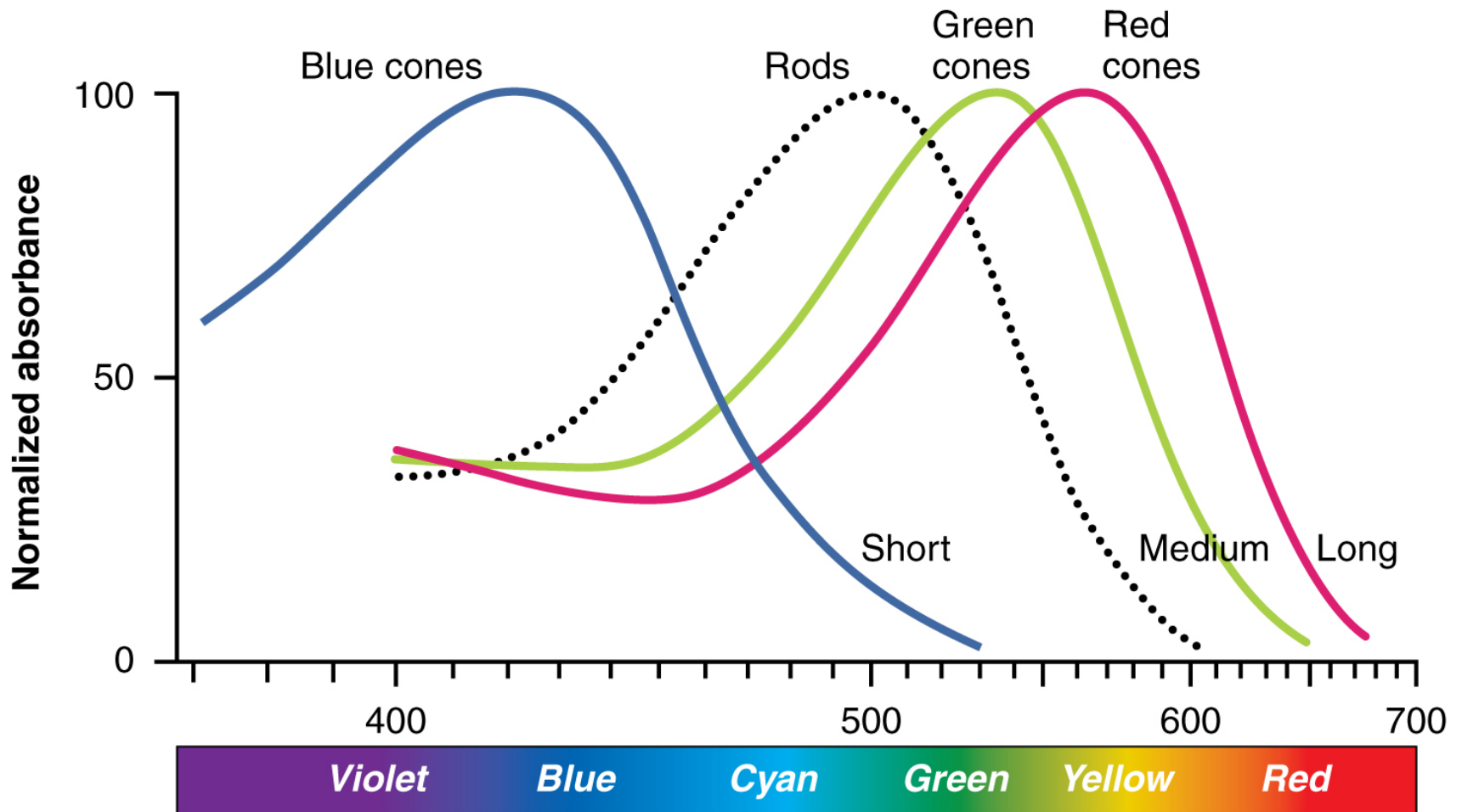


Photo Receptor Cells



Vision System(s)

- Low light vision is managed by rods
 - Scotopic vision system
 - Peak of efficiency around 500nm
 - Cannot distinguish colors
 - Activation requires a long time
- Normal light vision
 - Photopic vision system
 - Peak of efficiency at 560nm

Game #6

The image features two large, stylized parentheses, one on the left and one on the right, which serve as a frame for the central text. Each parenthesis is composed of multiple concentric, curved bands of color. The left parenthesis's colors transition from light green at the top to bright blue at the bottom. The right parenthesis's colors transition from yellow at the top, through orange and red, to magenta and 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

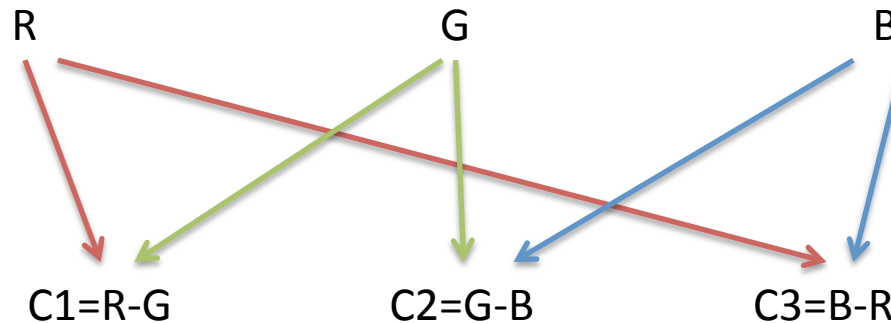
PQ-15-0343 TCX

Color 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



$$C1+C2+C3=0$$

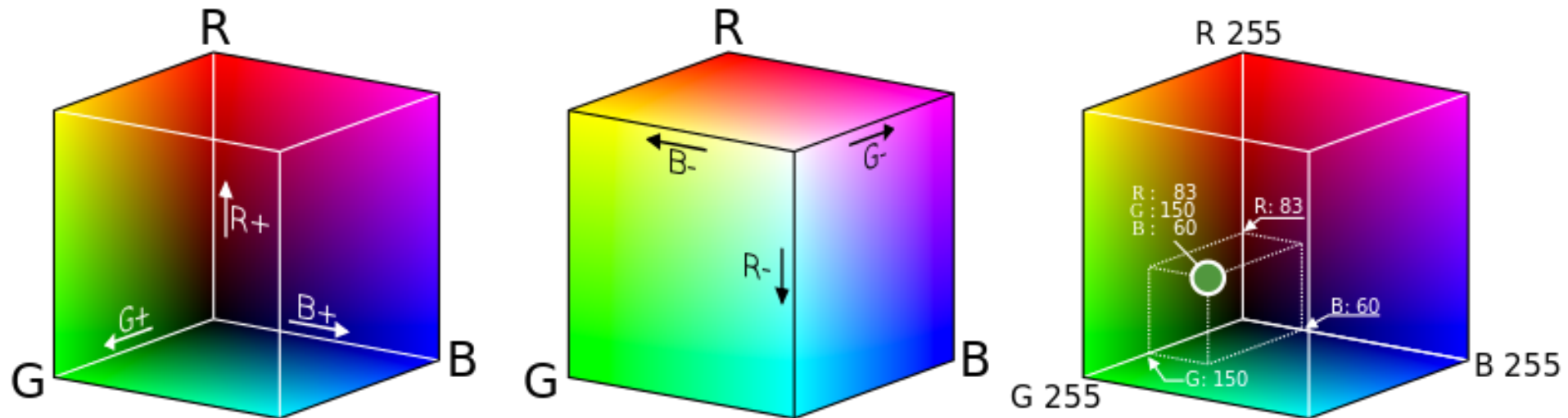
$$C1=R-G$$

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

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

RGB Color Model

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

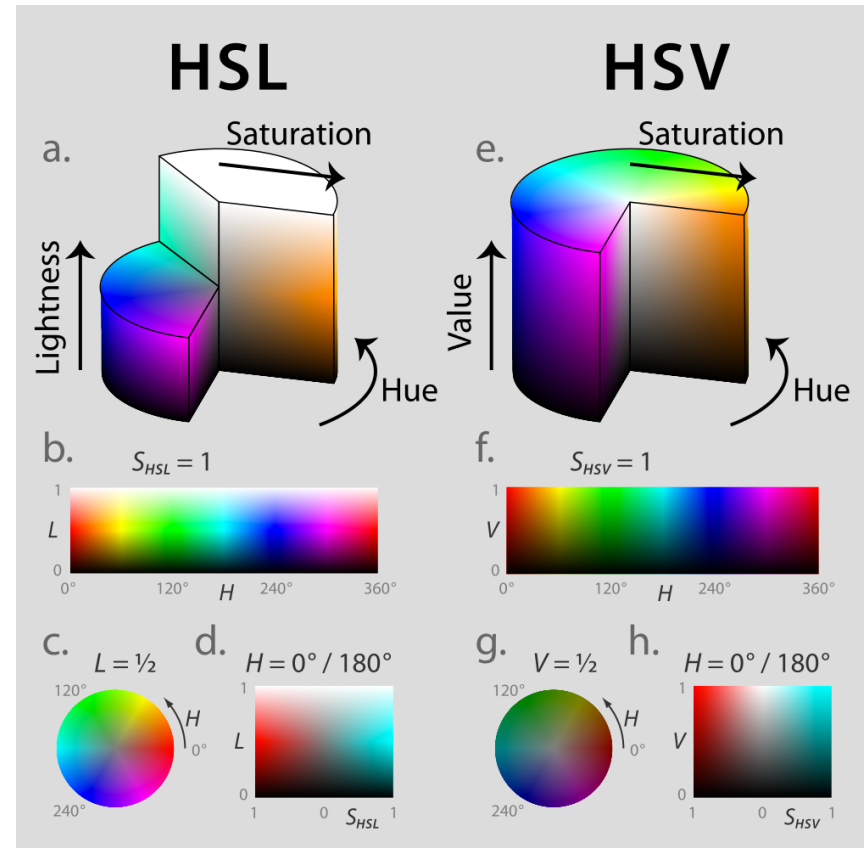


RGB Color Model

- 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?

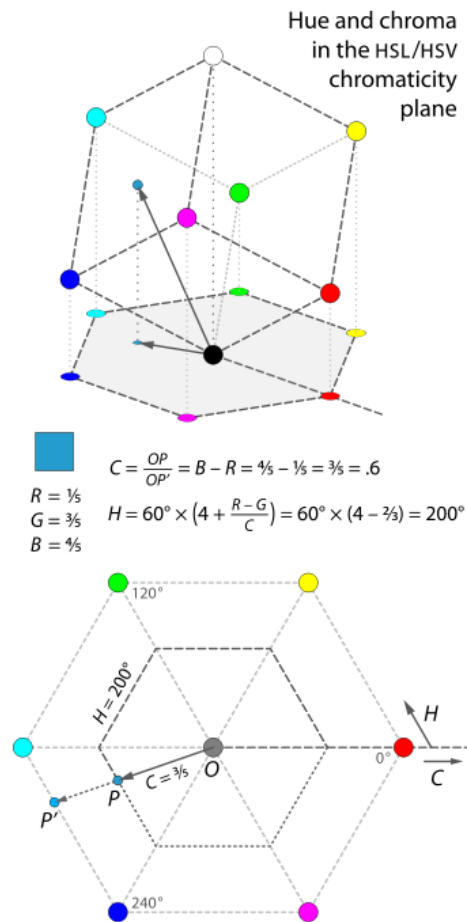
HSV Color Model

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

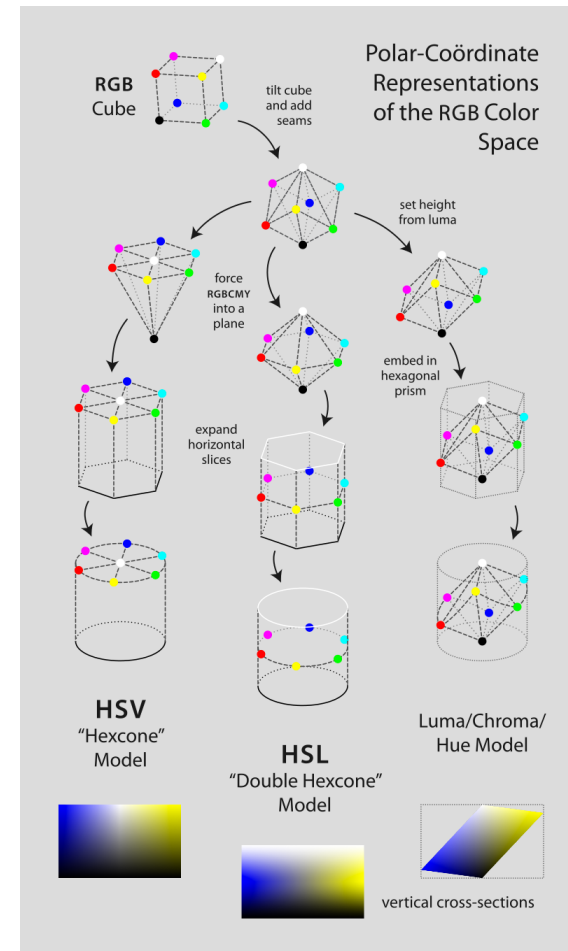


"Hsl-hsv models" by Jacob Rus - Own work. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Hsl-hsv_models.svg#/media/File:Hsl-hsv_models.svg

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>

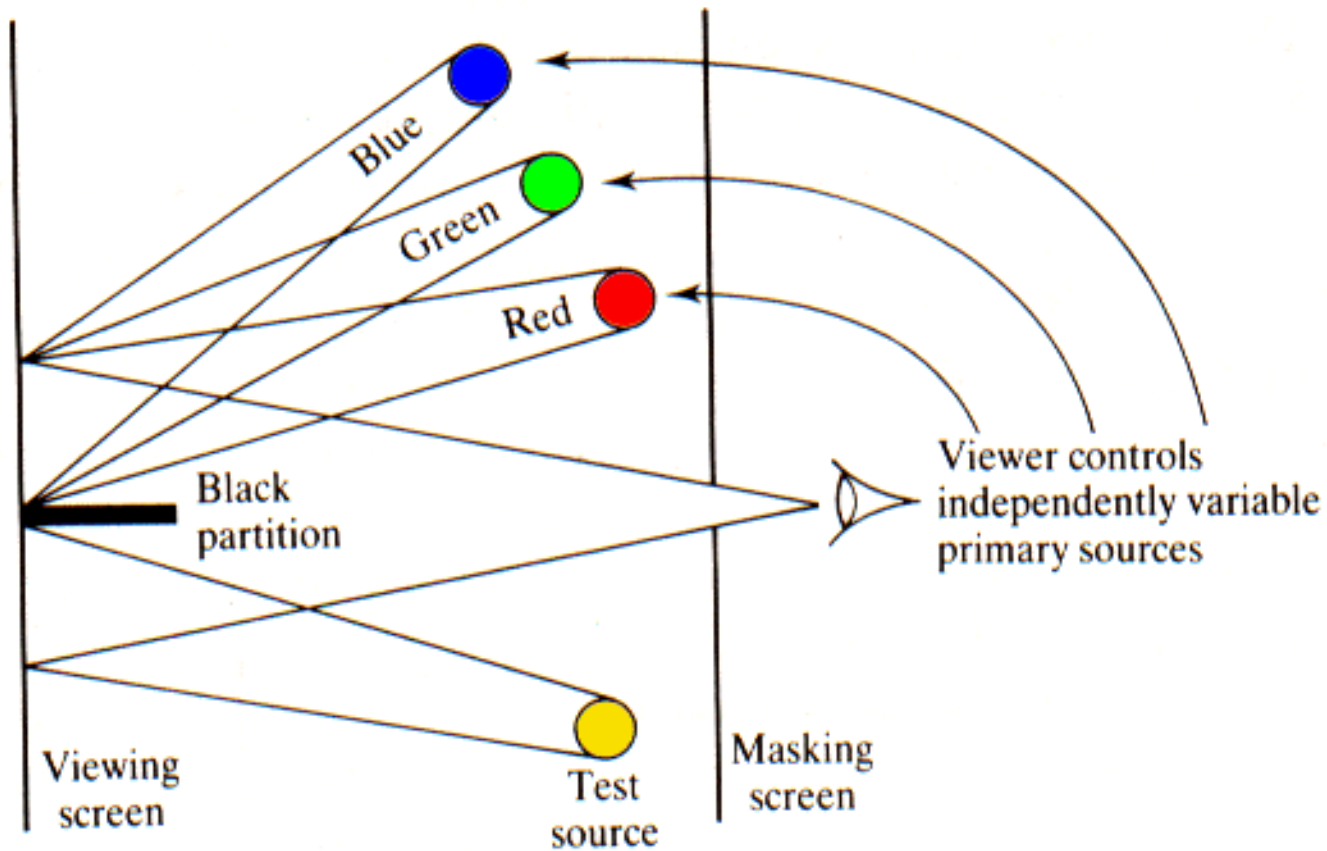


COLOURIMETRY

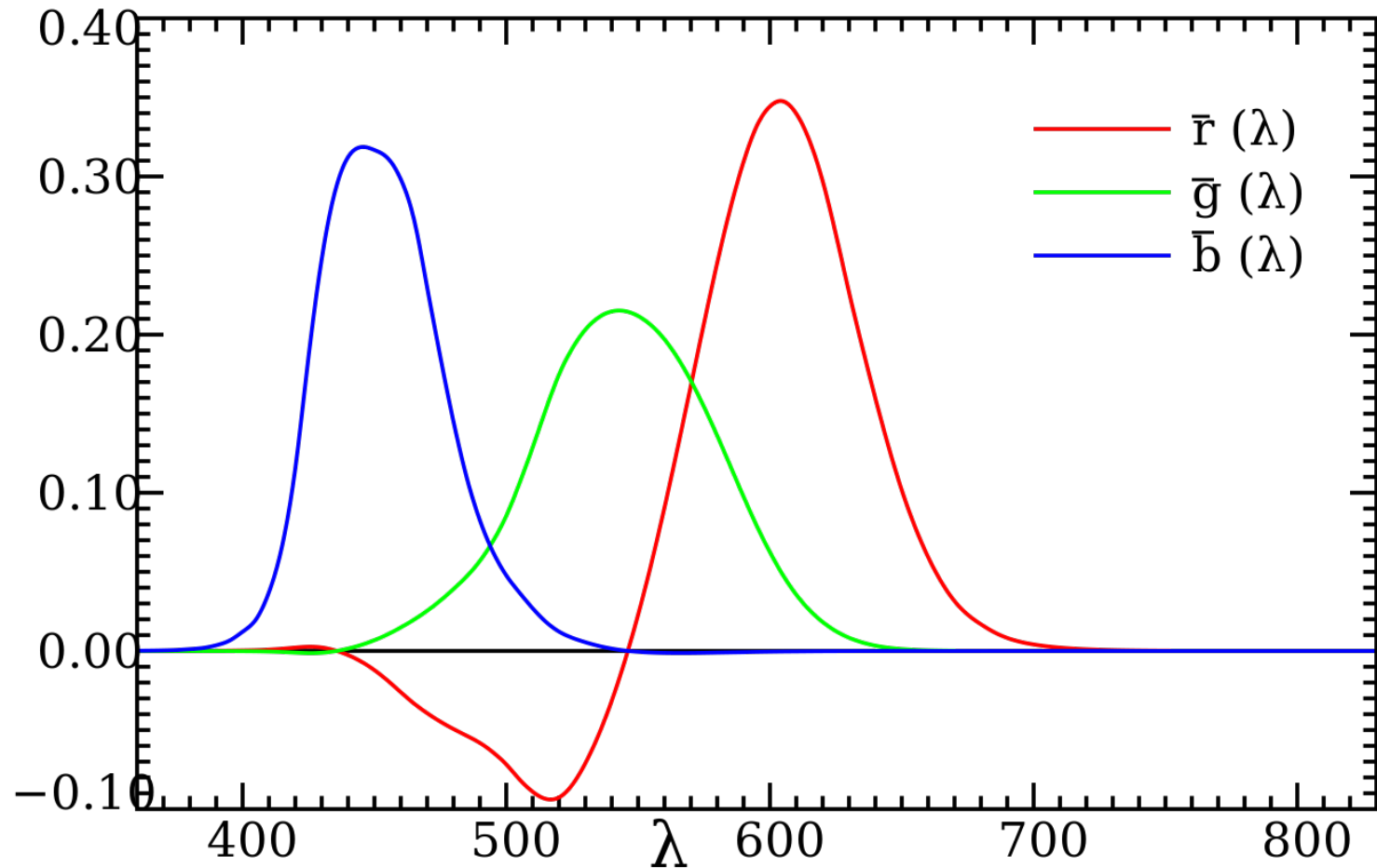
CIE Standard Observer

- 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

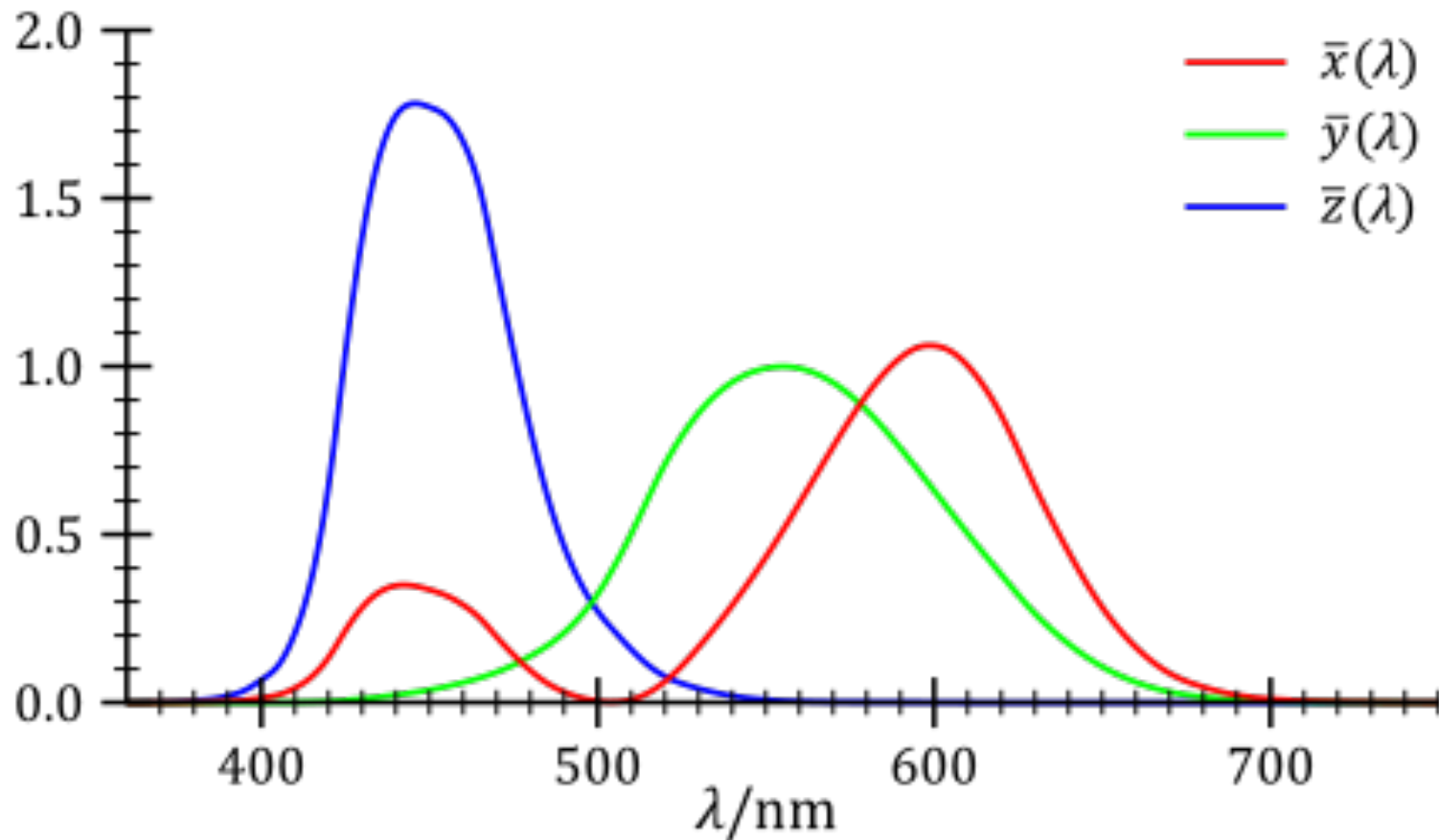


Standard Observer Results



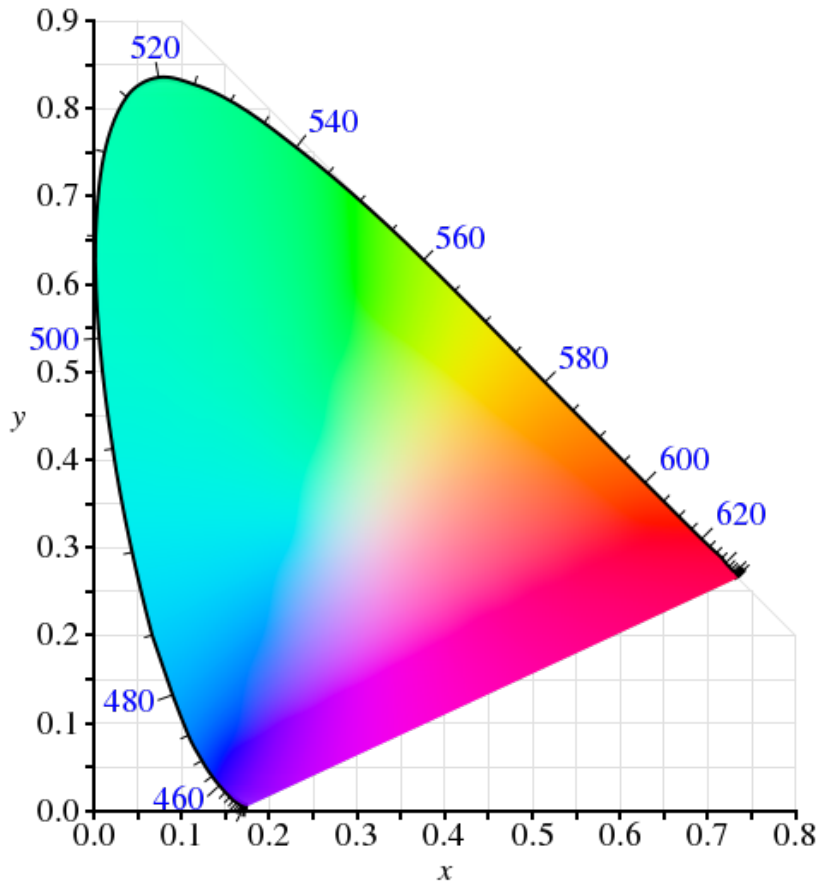
"CIE1931 RGBCMF" by Original uploader was Marco Polo at en.wikipedia - Transferred from en.wikipedia; Transfer was stated to be made by User:Kanie.. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:CIE1931_RGBCMF.svg#/media/File:CIE1931_RGBCMF.svg

Color Matching Functions: imaginary primary colors



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

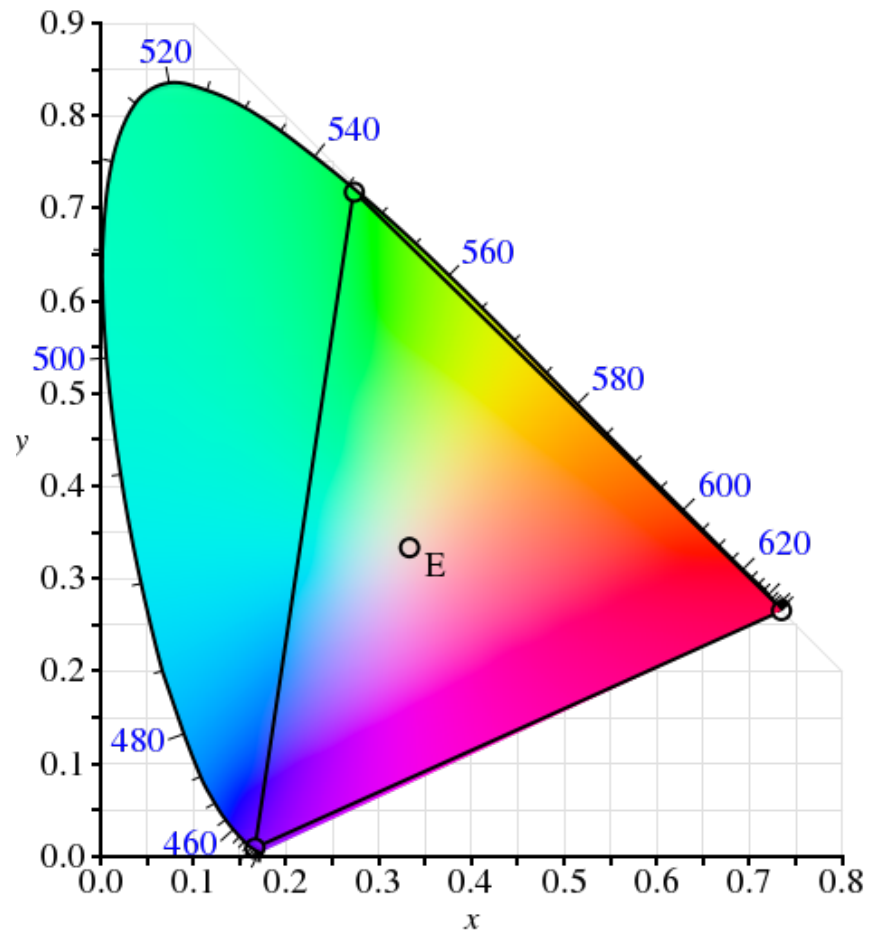
Chromaticity Diagram



- 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



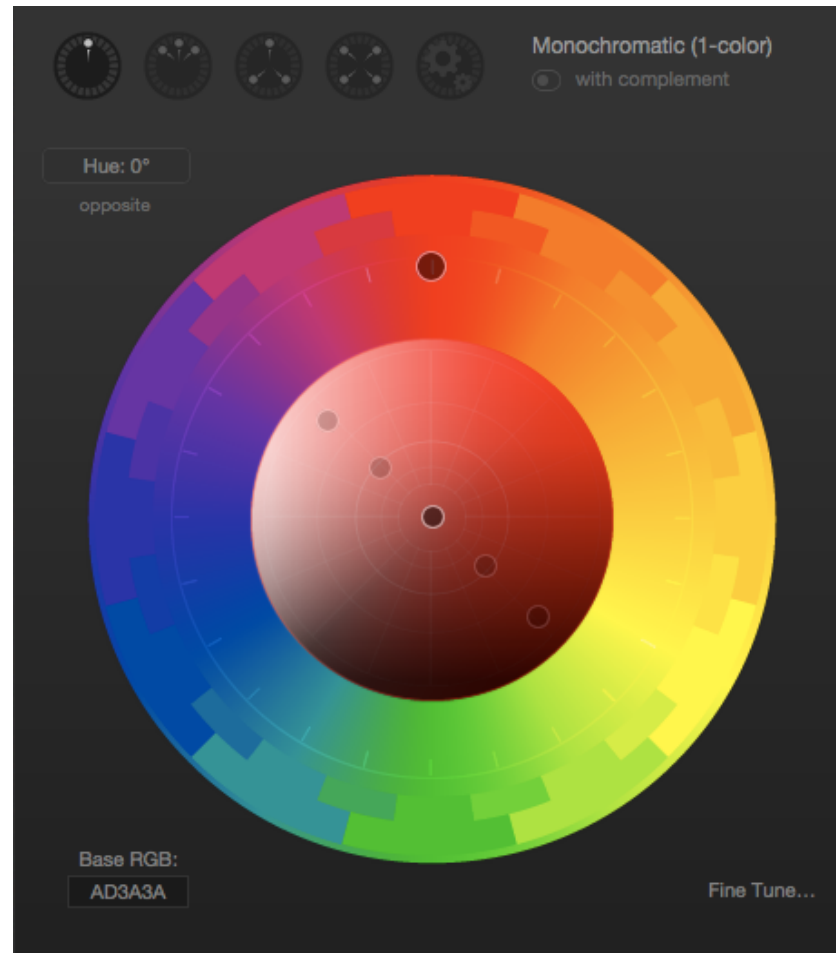
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PALETTE

Color Schemes

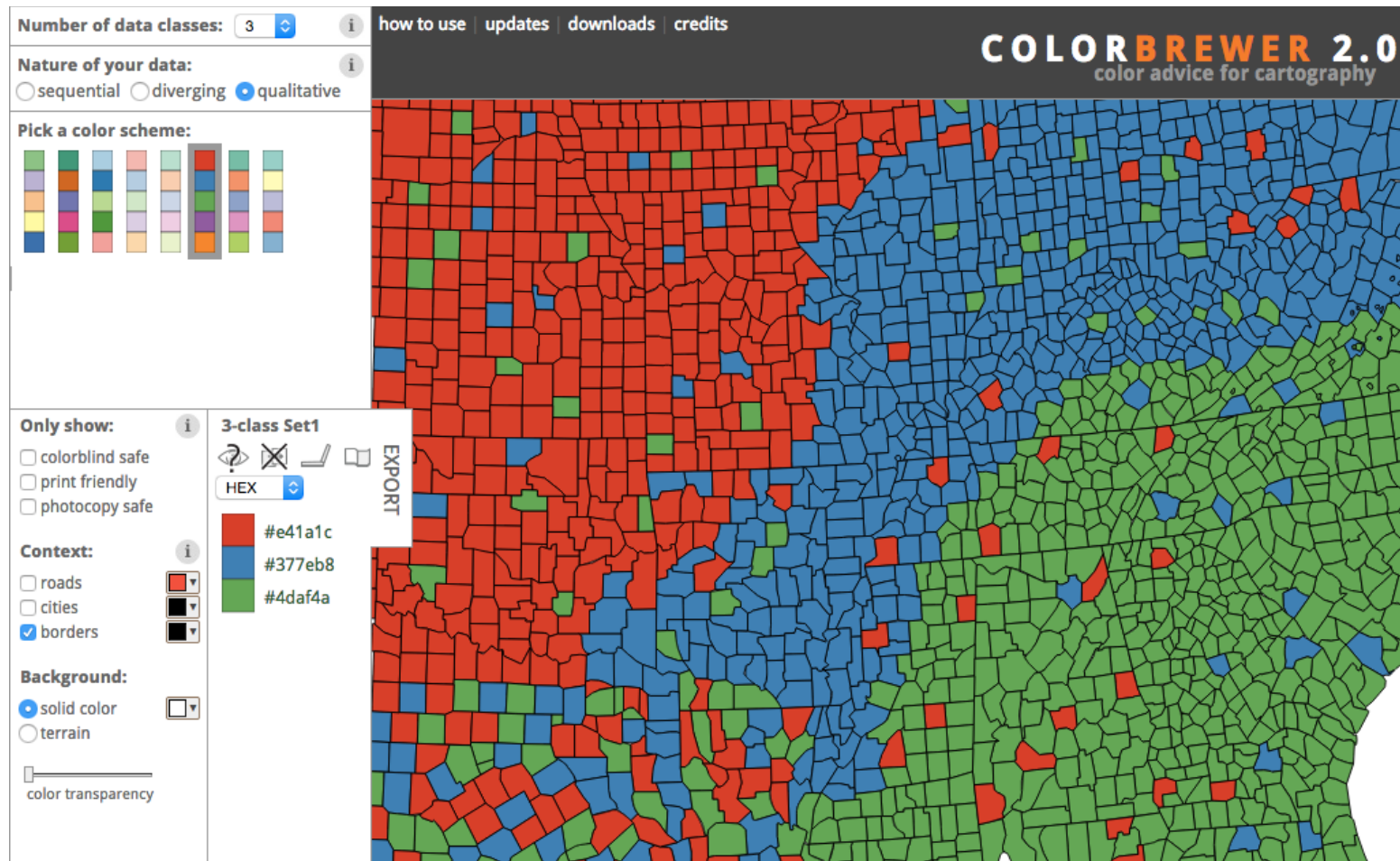
Cold colors



Warm colors

<http://paletton.com/>

Color Schemes for Cartography



<http://colorbrewer2.org/>



Takeaway Messages

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