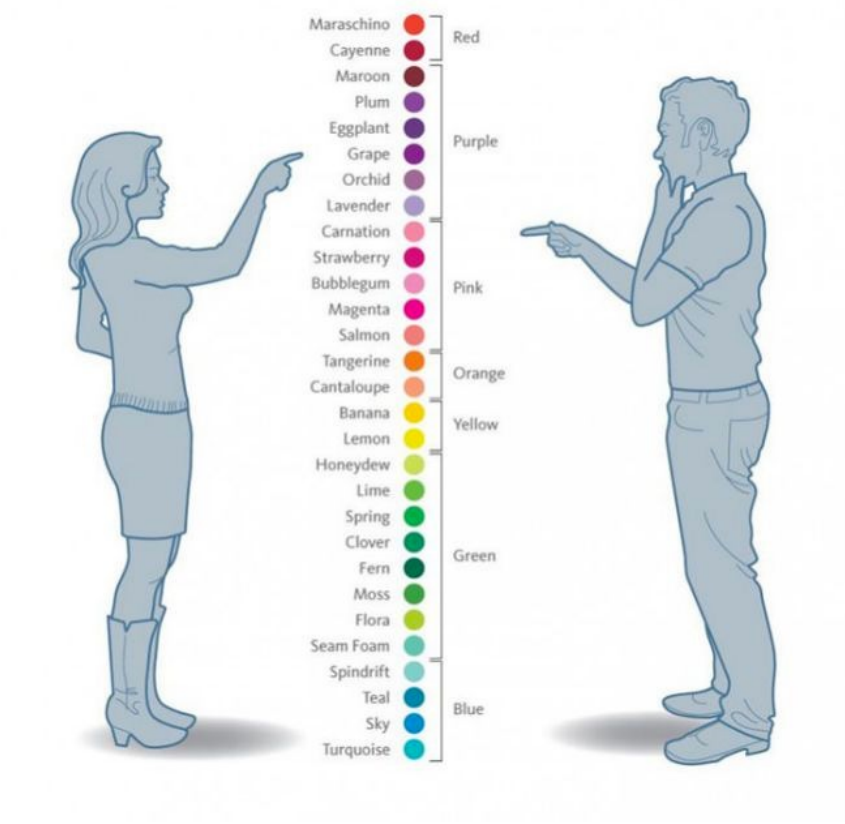
4 COLORS

S. Rinzivillo – rinzivillo@isti.cnr.it

HOW MANY COLOR?

Female



Male

Dog

Programmer

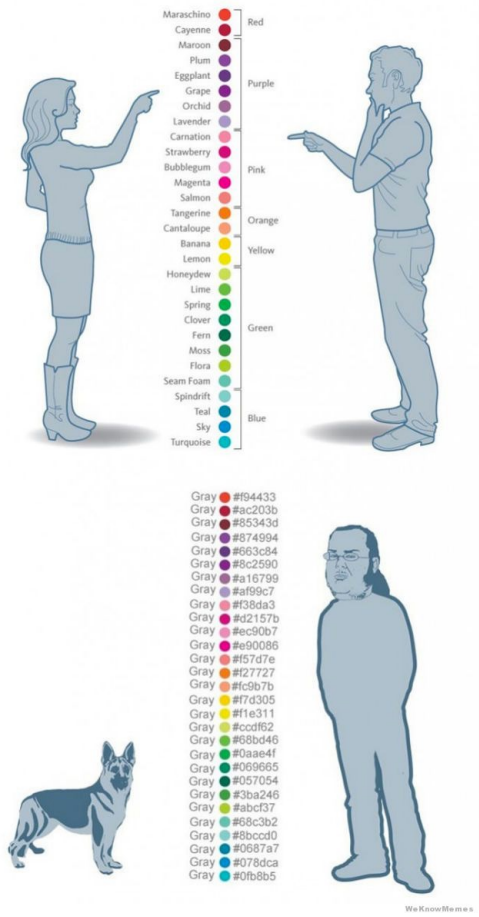
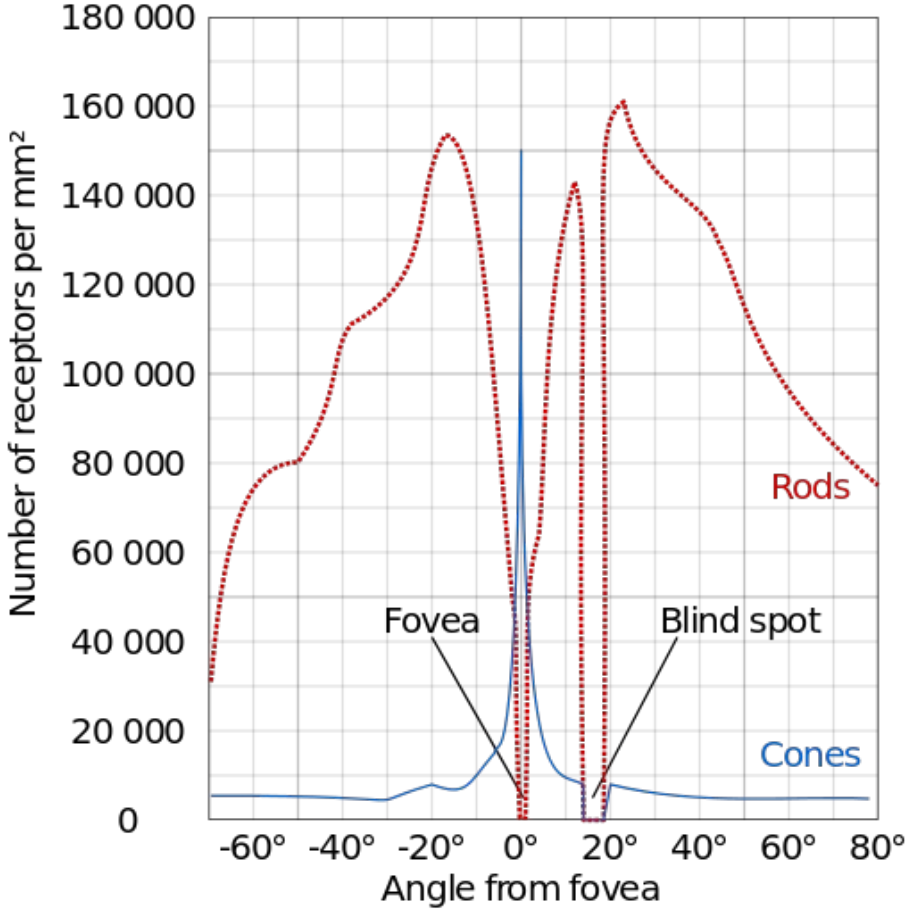


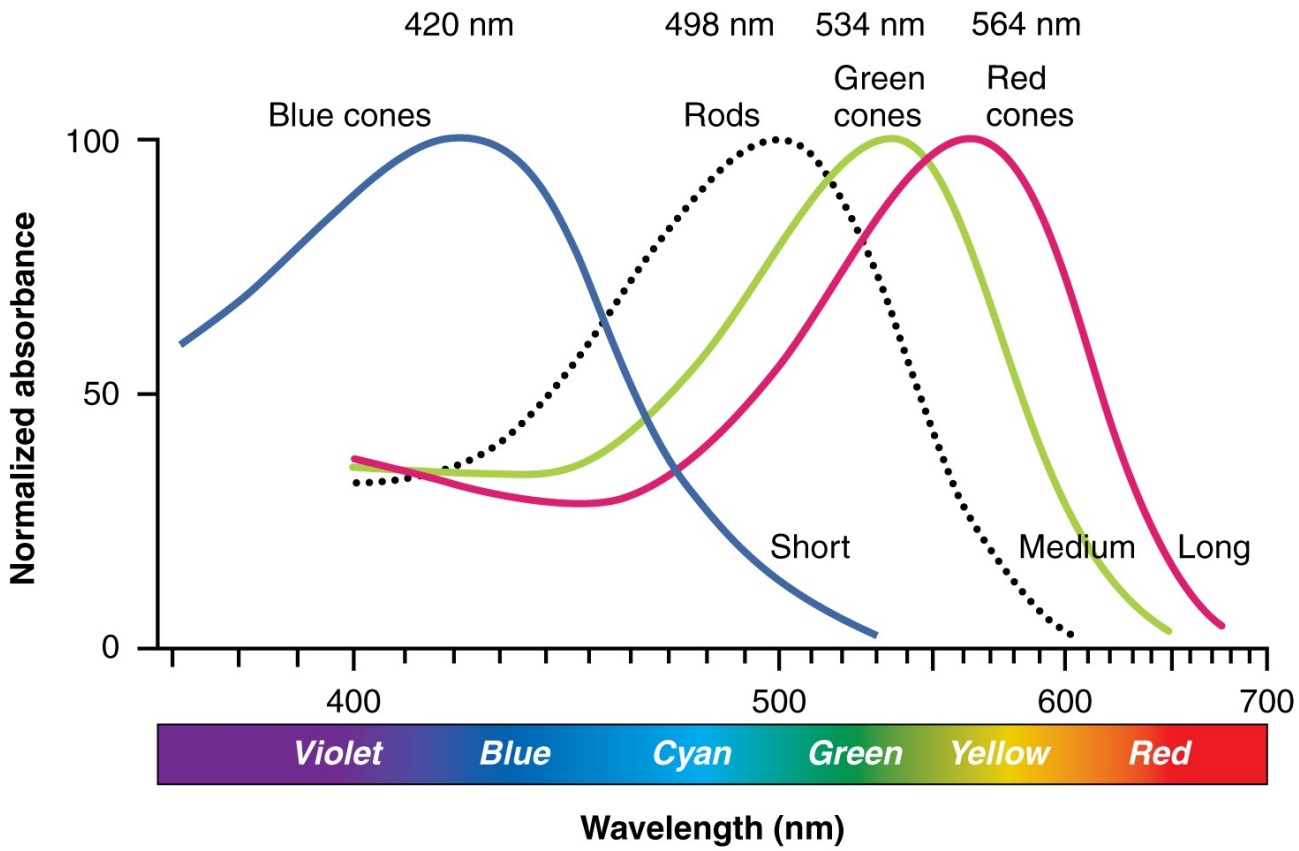
PHOTO RECEPTOR CELLS

- 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.. Licensed under CC BY 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:1416_Color_Sensitivity.jpg#mediaviewer/File:1416_Color_Sensitivity.jpg

TEST YOUR COLOR PERCEPTION

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

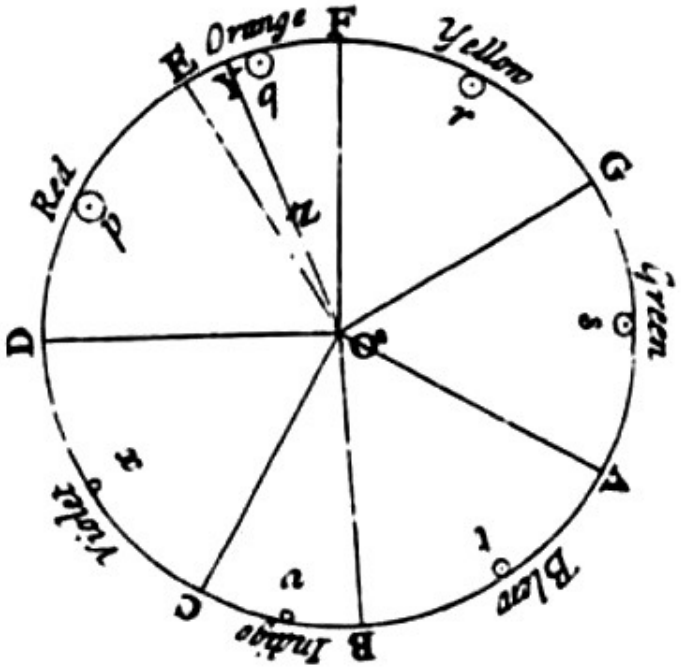
FASHION, HOME + INTERIORS (plastica)
PQ-16-1546TCX

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

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

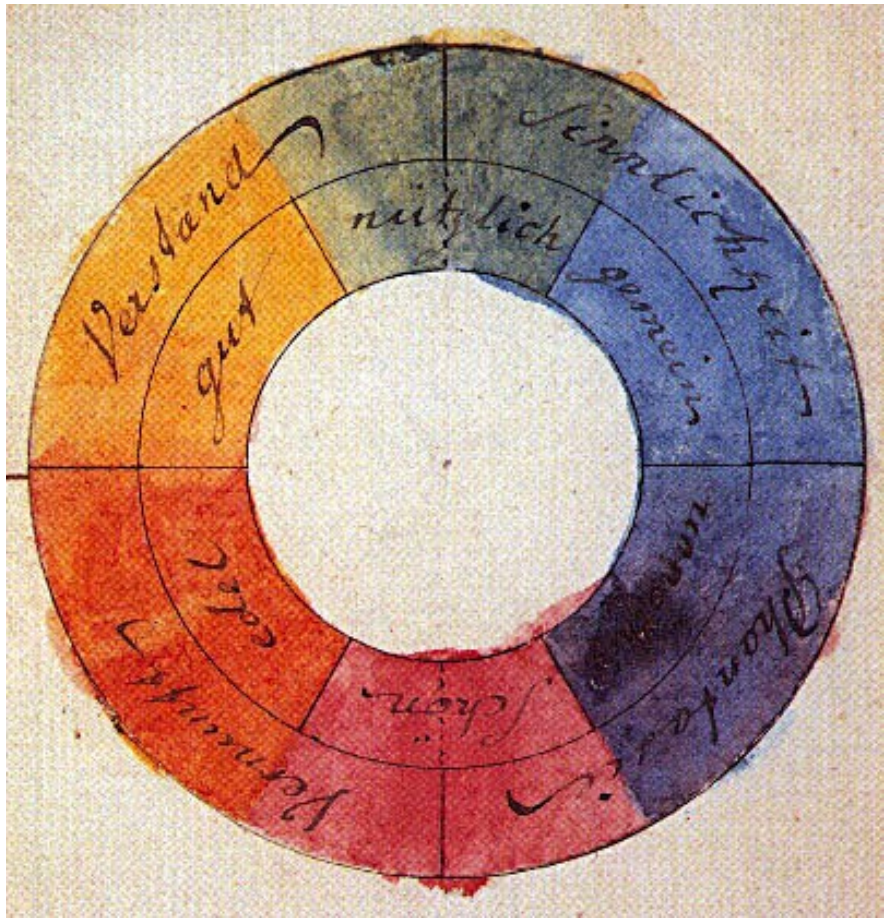
COLOR MODEL – NEWTOW (OPTICKS. 1704)

- White light is a combination of all colors
- Could recombine colors back to white light
- Wrapping basic colors around a circle

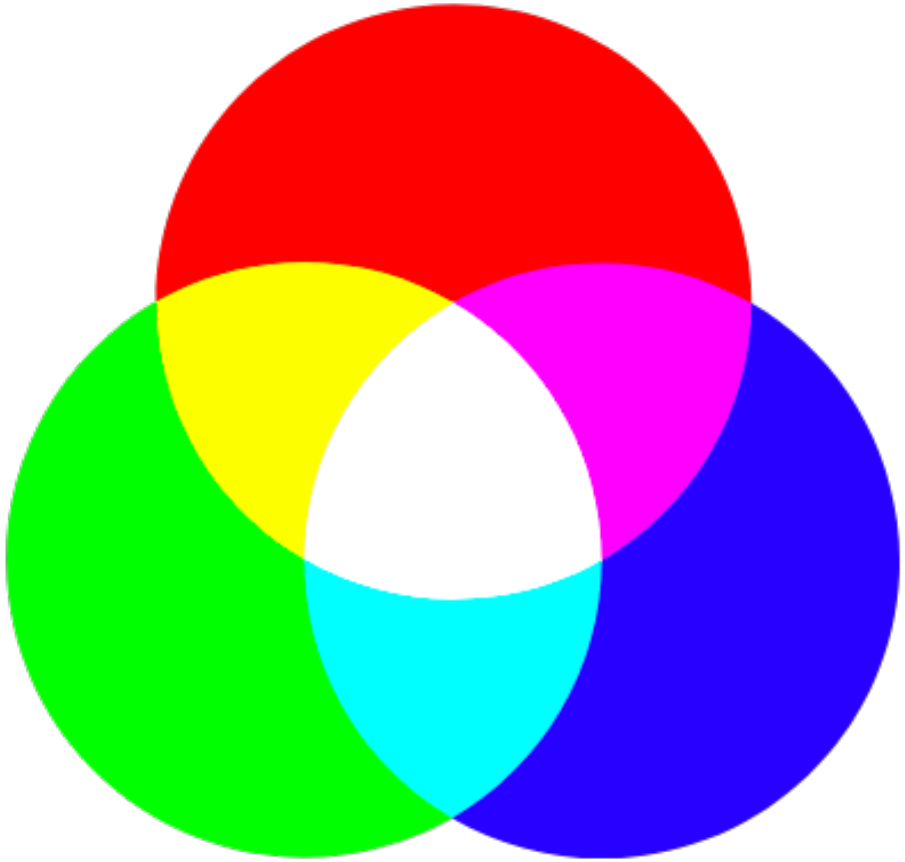


COLOR MODEL – COLOR CIRCLE (GOETHE, 1810)

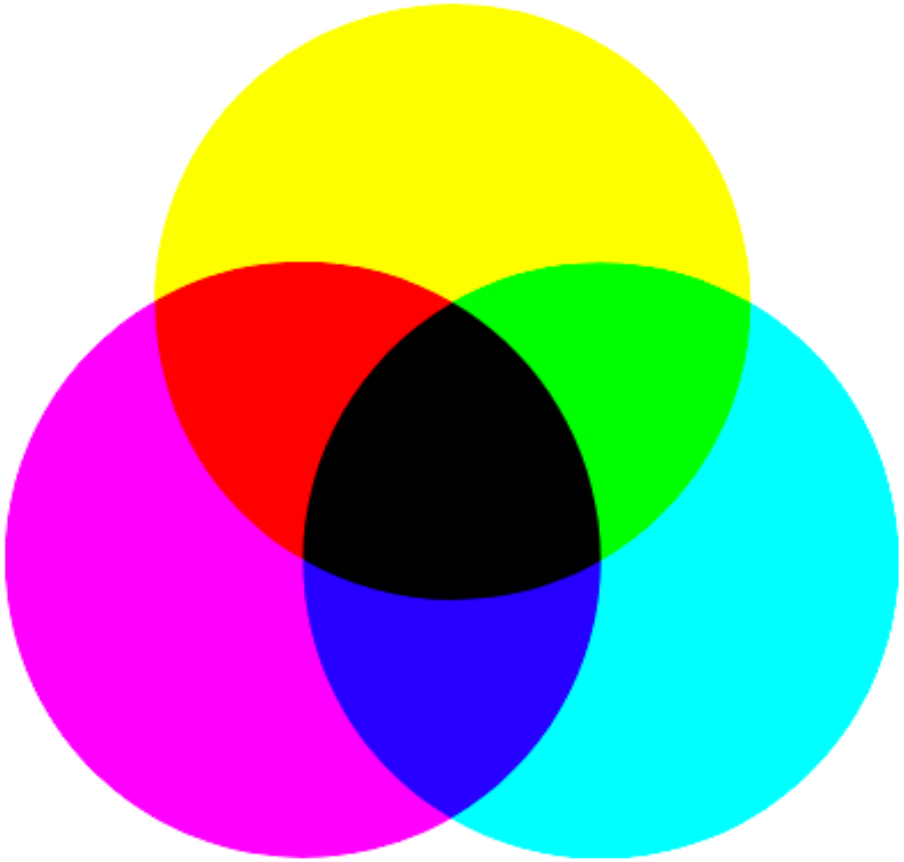
- Measures of eye's response to color
- Three primary colors:
  - Magenta, yellow, blue



COLOR MODELS – ADDITIVE AND SUBTRACTIVE MODELS

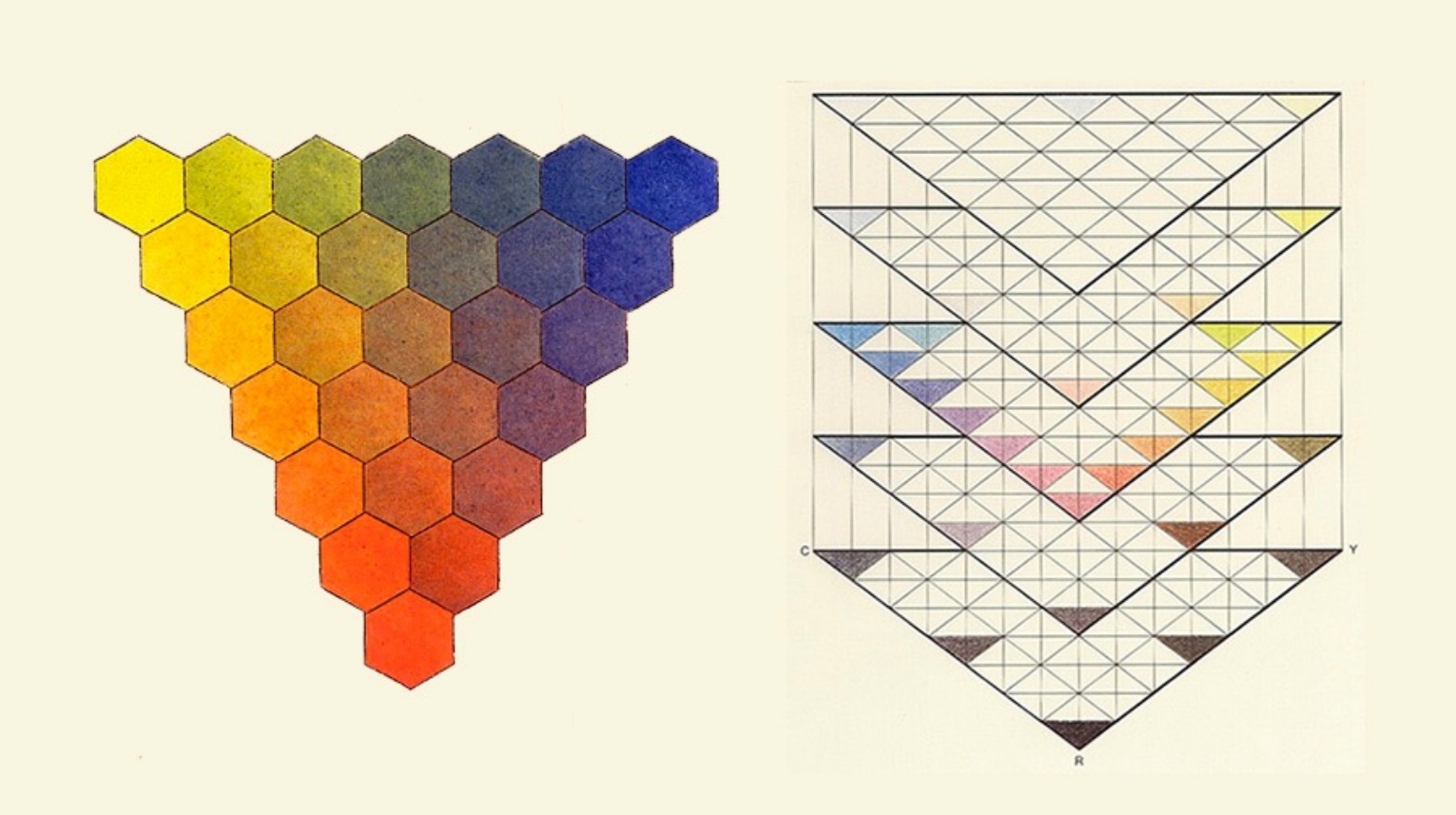


RGB additive model



CMY subtractive model

COLOR MODELS – 3D SPACE MODELS (MAYER, 1775)



Problem: steps are not perceptually uniform

COLOR MODELS – MUNSELL (EARLY 1900'S)

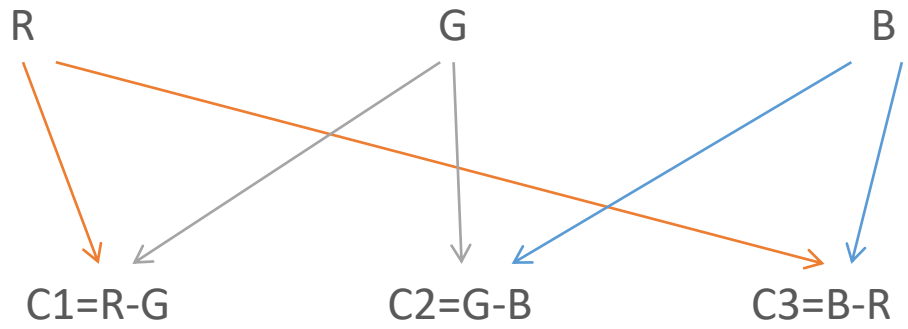
- Introduction of three new dimensions
  - HUE (red, blue, etc)
  - Value (light or dark)
  - Chroma (saturation)
- Irregular shape of solid
  - Low brightness implies fewer visible colors
- Introduction of a mathematical definition of colors (not names)

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



C1+C2+C3=0

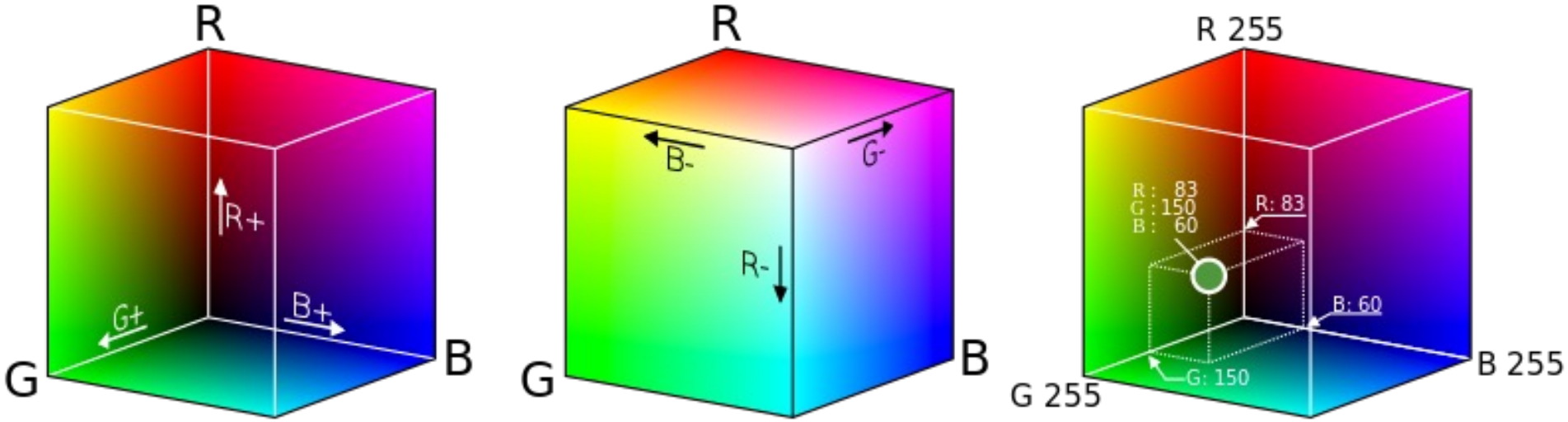
C1=R-G

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



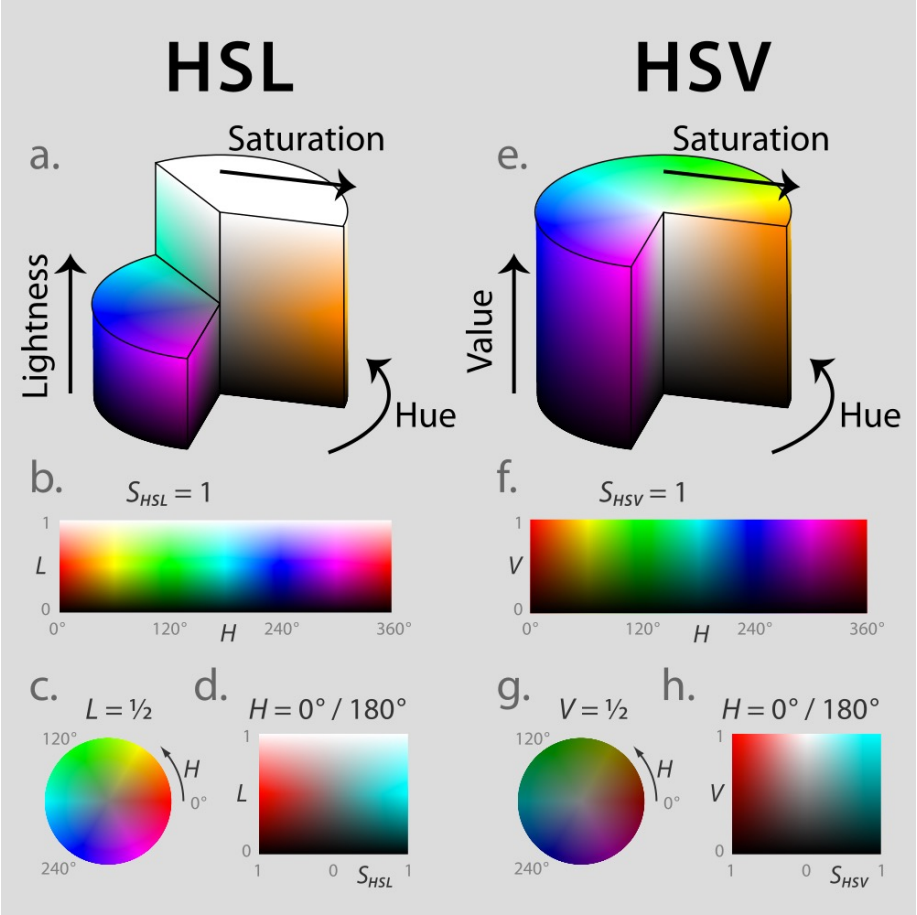
"RGB color cube" by User:Maklaan - Own workbased on:RGB_farbwuerfel.jpg by Horst Frank. Licensed under CC BY-SA 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:RGB_color_cube.svg#/media/File:RGB_color_cube.svg

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?

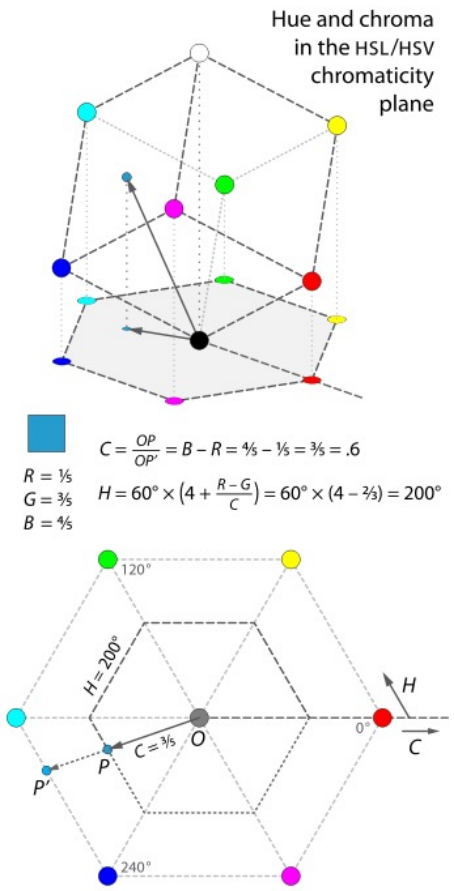
HSV COLOR MODEL

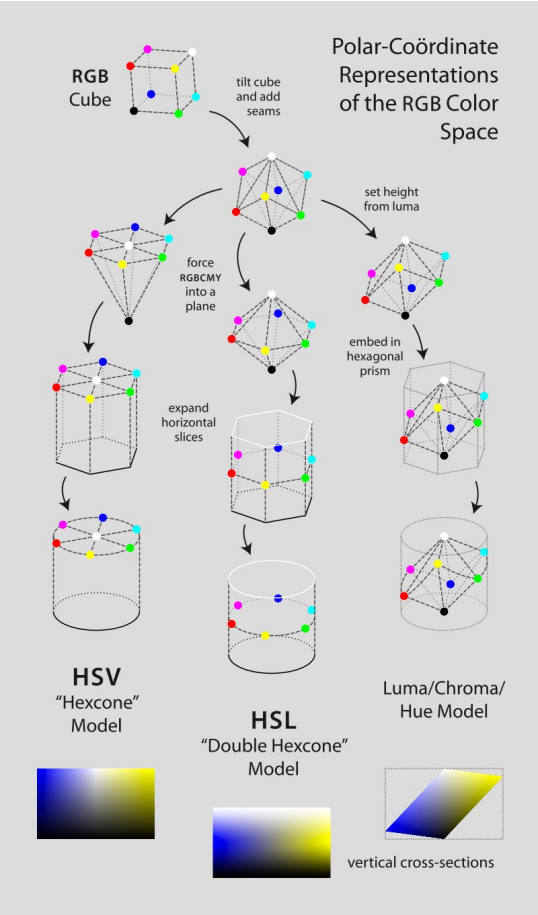
- Based on the intuitive concepts of
  - Hue
  - Saturation
  - Value (or brightness: 0% implies black; 100% implies pure color)
  - Lightness (or luminosity: 0% implies black; 50% implies pure color; 100% implies white)
- Component values are expressed in ranges [0,1] or [0,255]



"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

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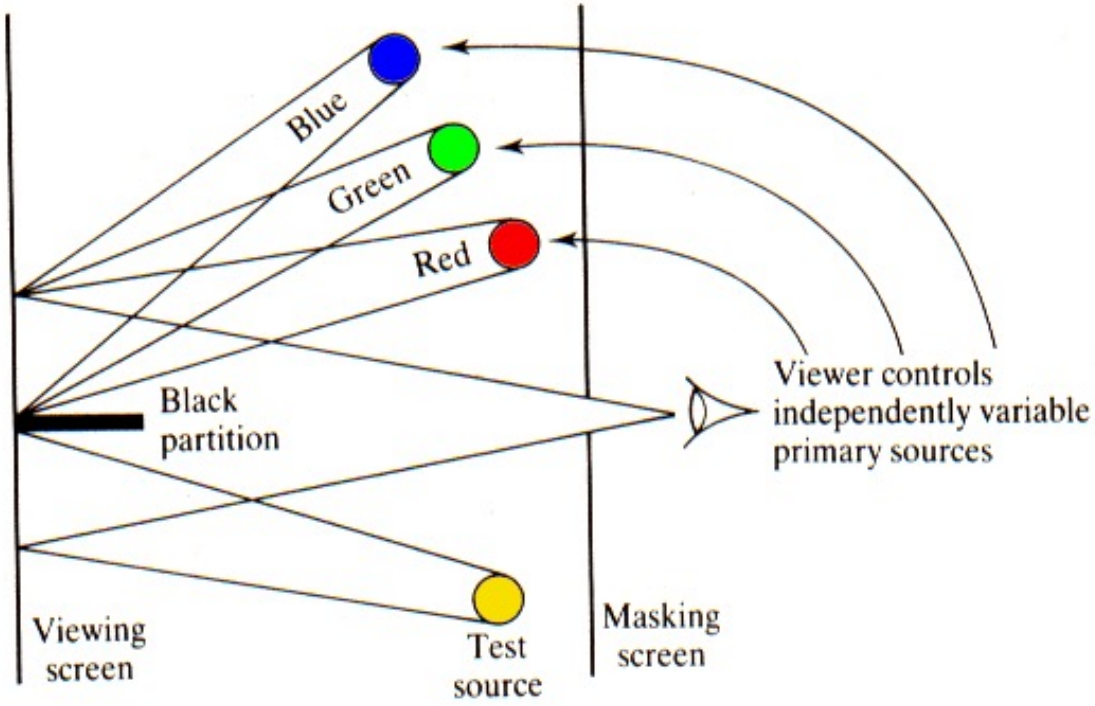
COLOR SPACES

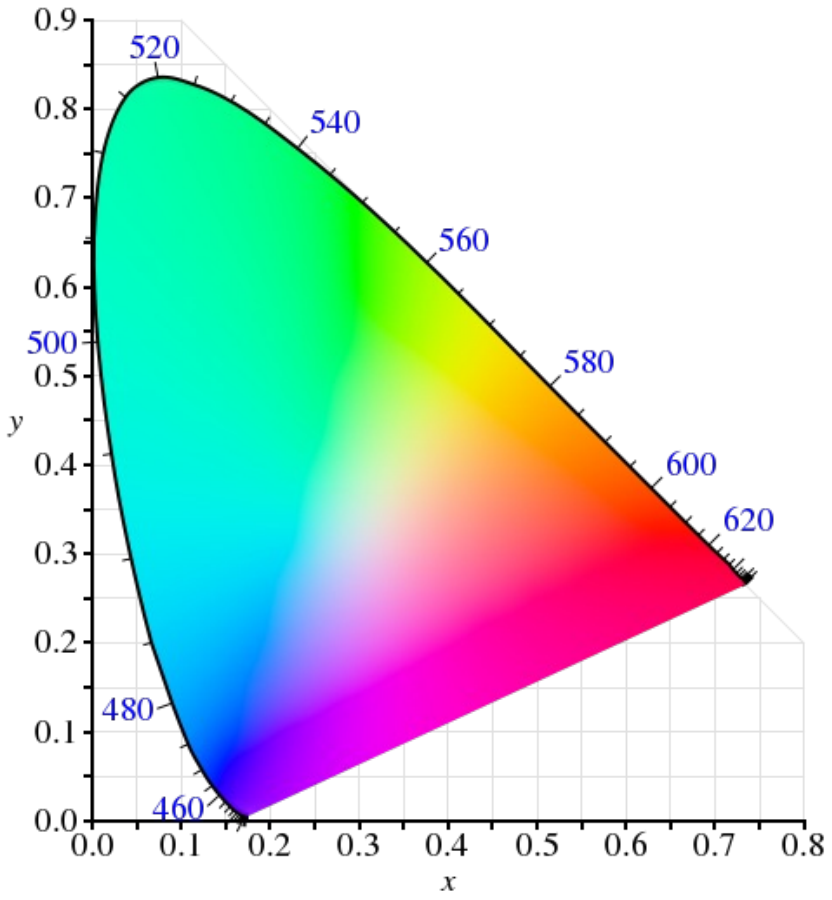
CIE STANDARD OBSERVER

- 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



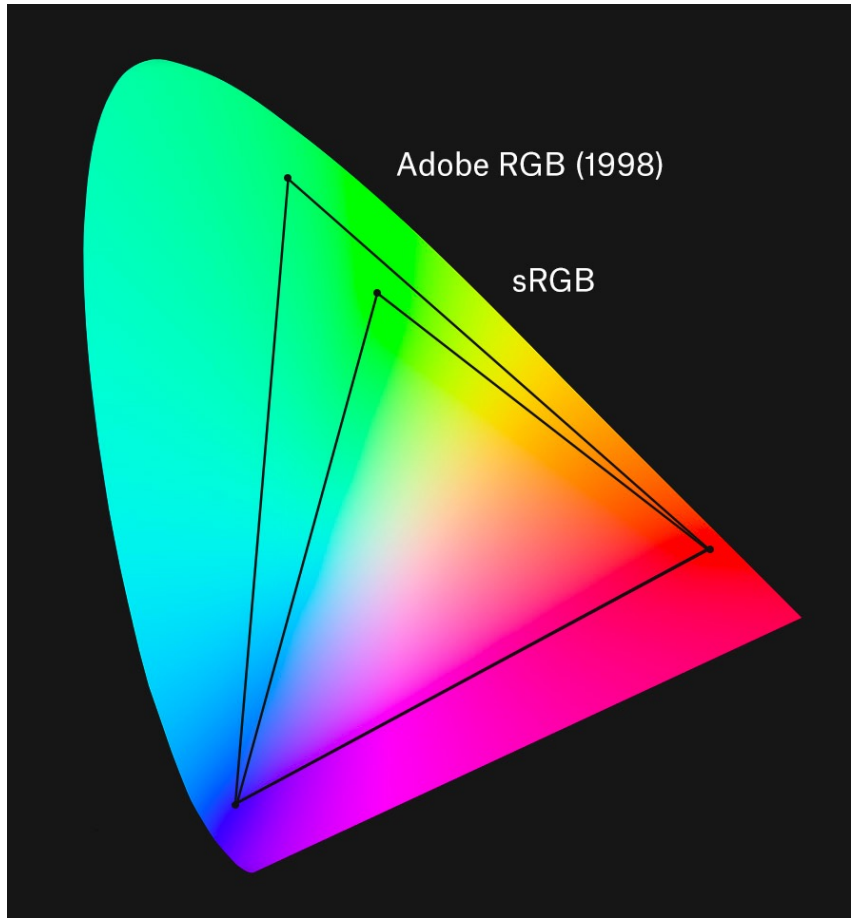
CHROMATICITY DIAGRAM

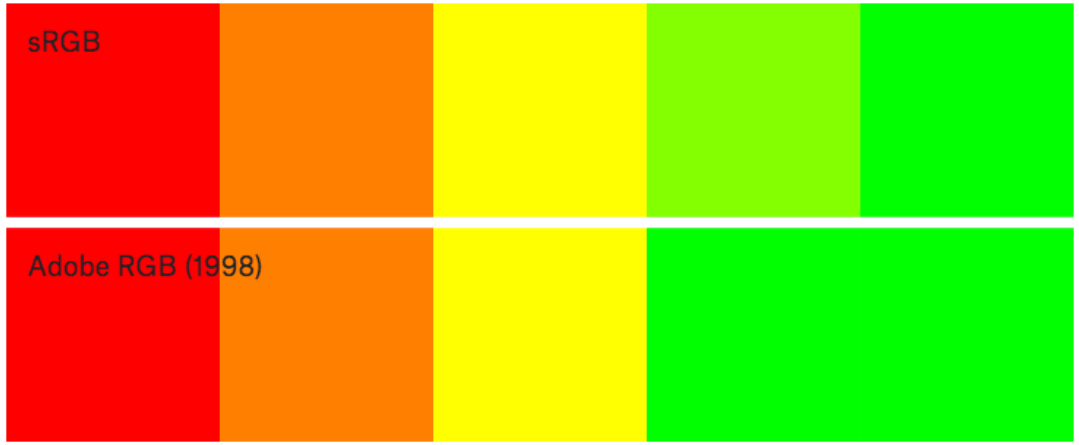


- A mixture of two colors lies on the line connecting the two colors
- Chromaticity Diagram (gamut) is convex
- All visible colors are non-negative combination of x, y, and z
- An equal combination of two colors does not lie in the mid-point

"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

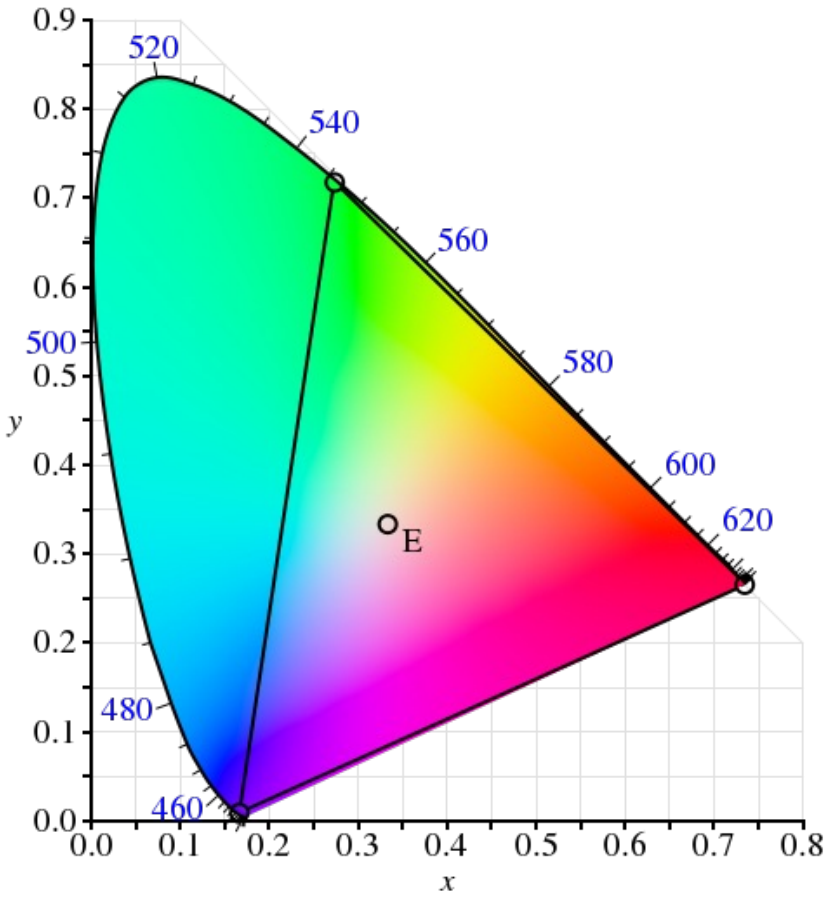
COMPARING COLOR SPACES





COLOR MIXING

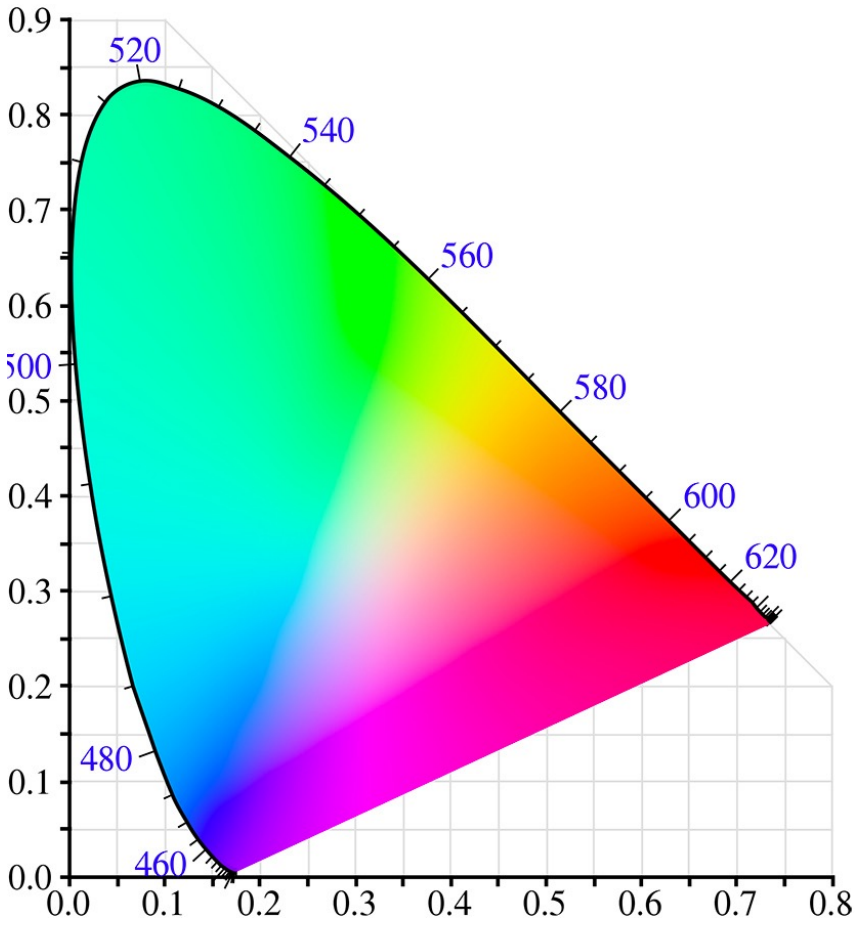
- Given three primary colors, the corresponding triangle cannot cover the whole gamut



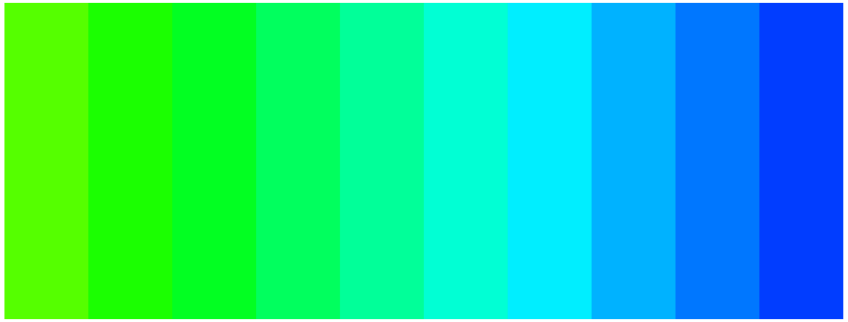
"CIE1931xy CIERGB" by BenRG - Own work, inspired by File:CIExy1931.png. Licensed under Public Domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:CIE1931xy_CIERGB.svg#/media/

PALETTE

MAPPING VALUES TO COLOR SCHEMES



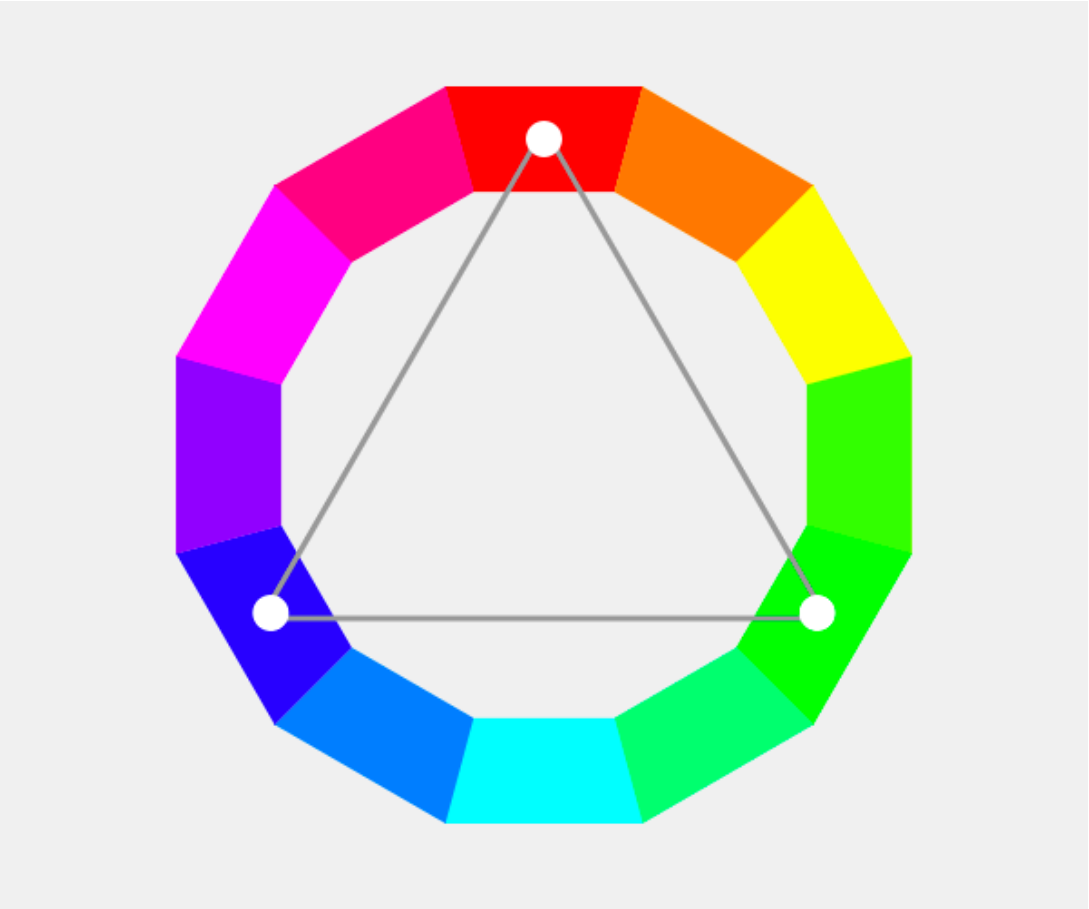
sRGB interpolation



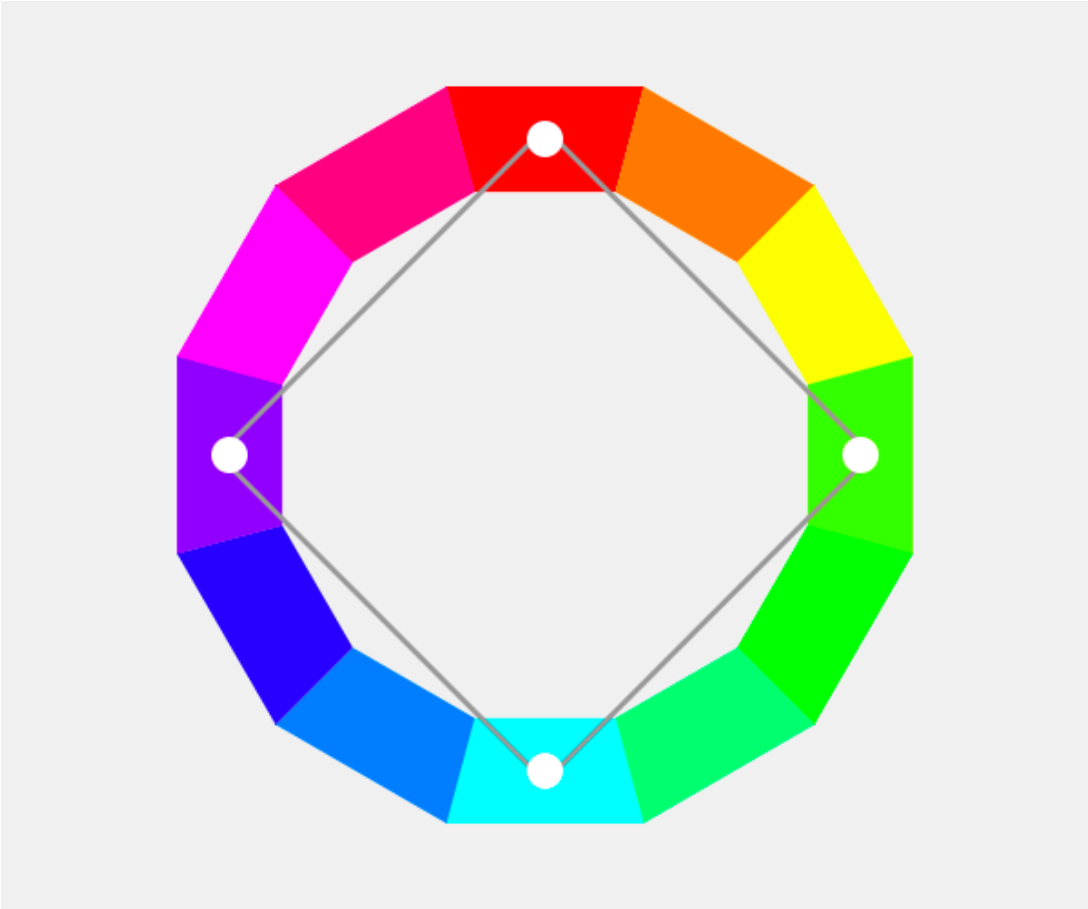
Perceptually uniform color space

HSLuv project provides utilities to colors among different color spaces

CATEGORIES OF COLORS



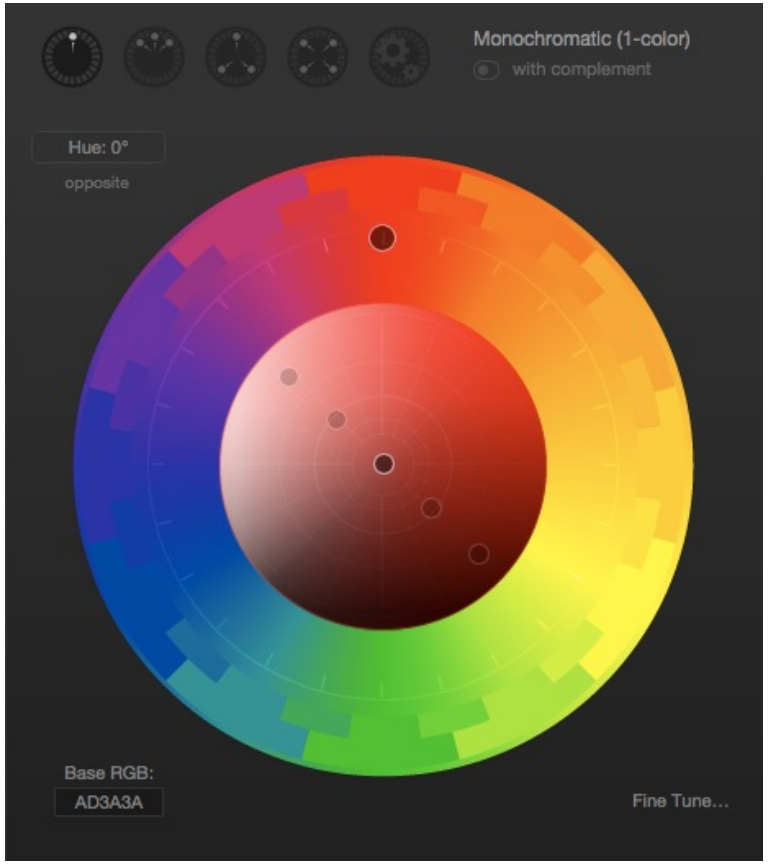
Triadic colors



Tetradic colors

COLOR SCHEMES

Cold colors



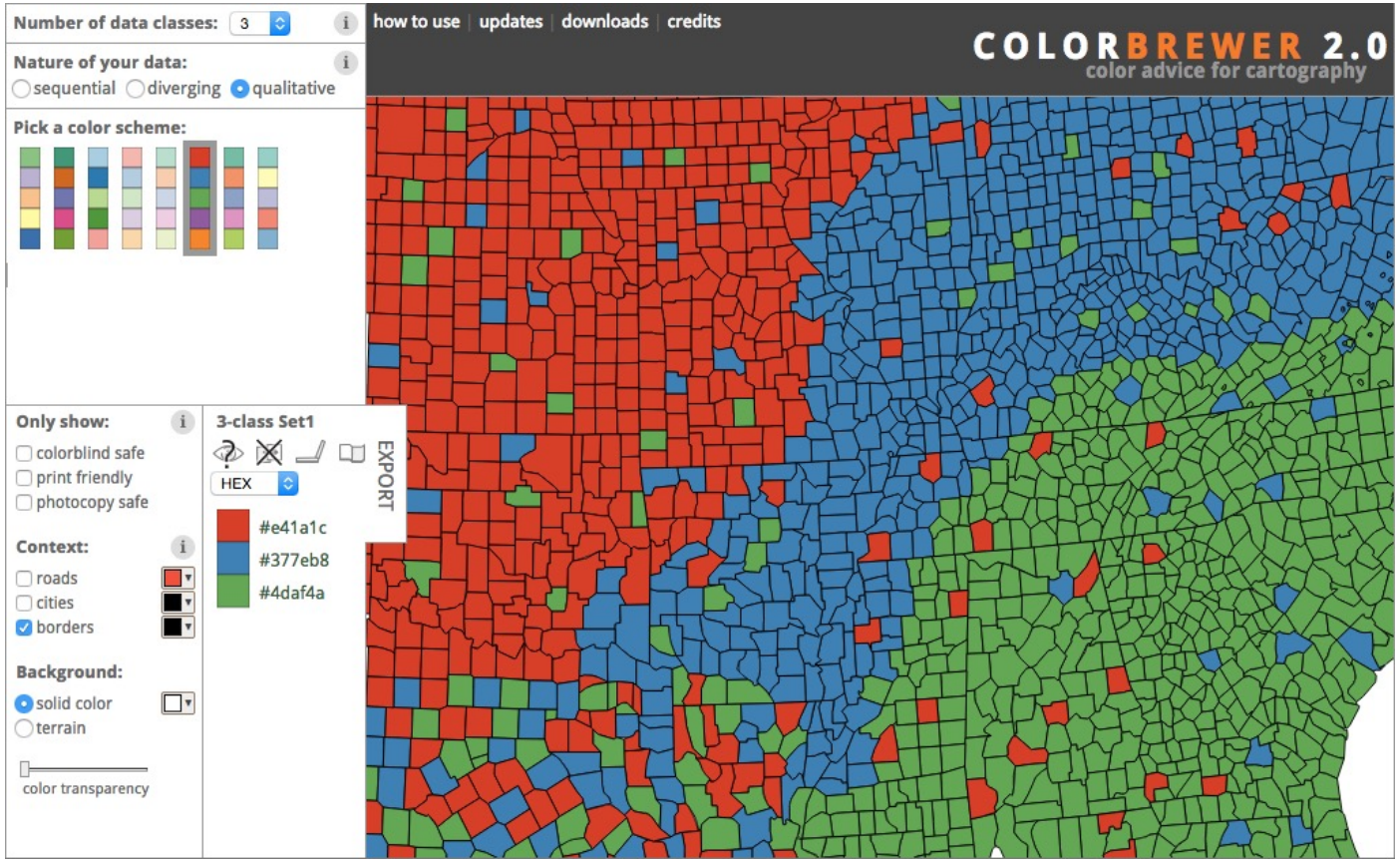
Warm colors

http://paletton.com/

COLOR BLINDNESS

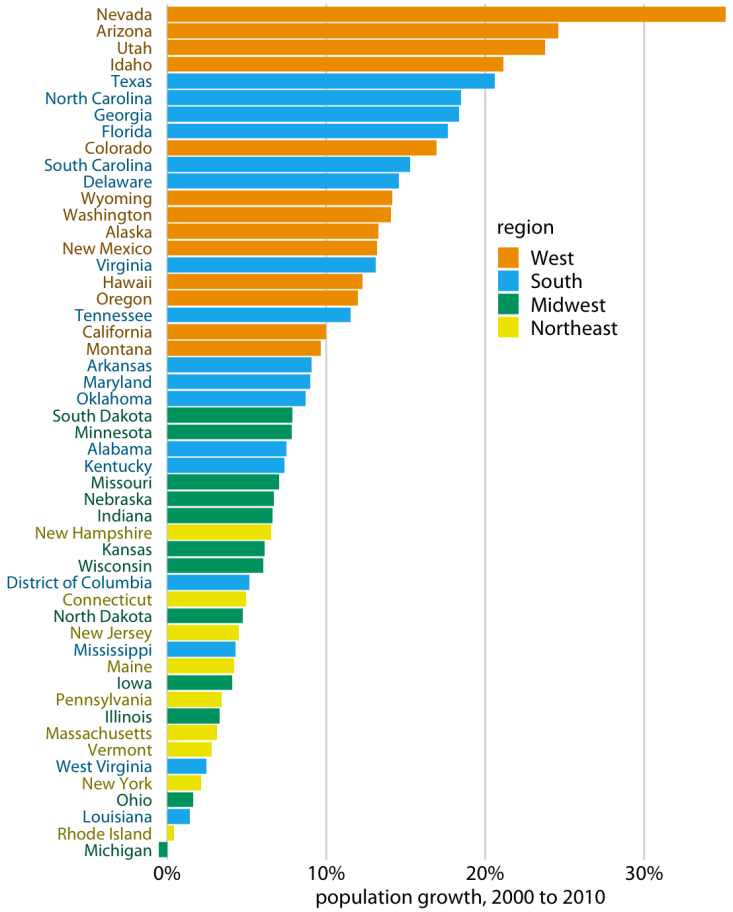
Normal color vision. Mild red-green blindness. Severe red-green blindness.

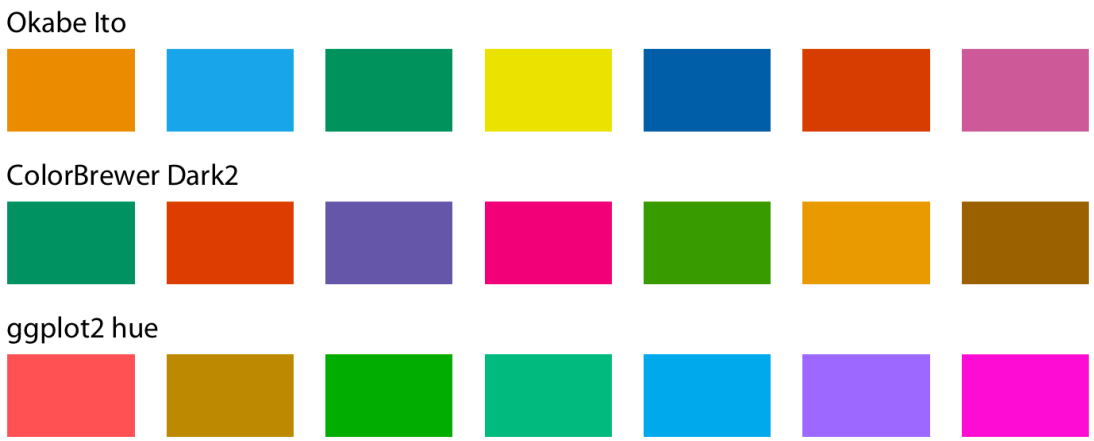
COLOR SCHEMES FOR CARTOGRAPHY



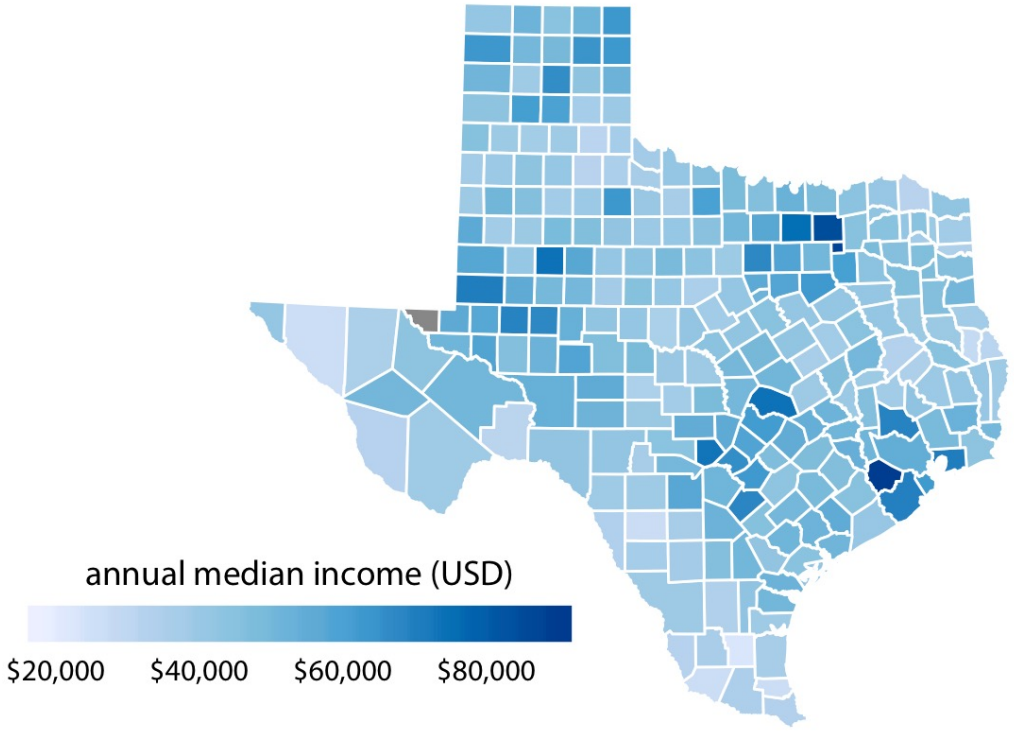
http://colorbrewer2.org/

COLOR SCHEME EXAMPLE (NOMINAL)

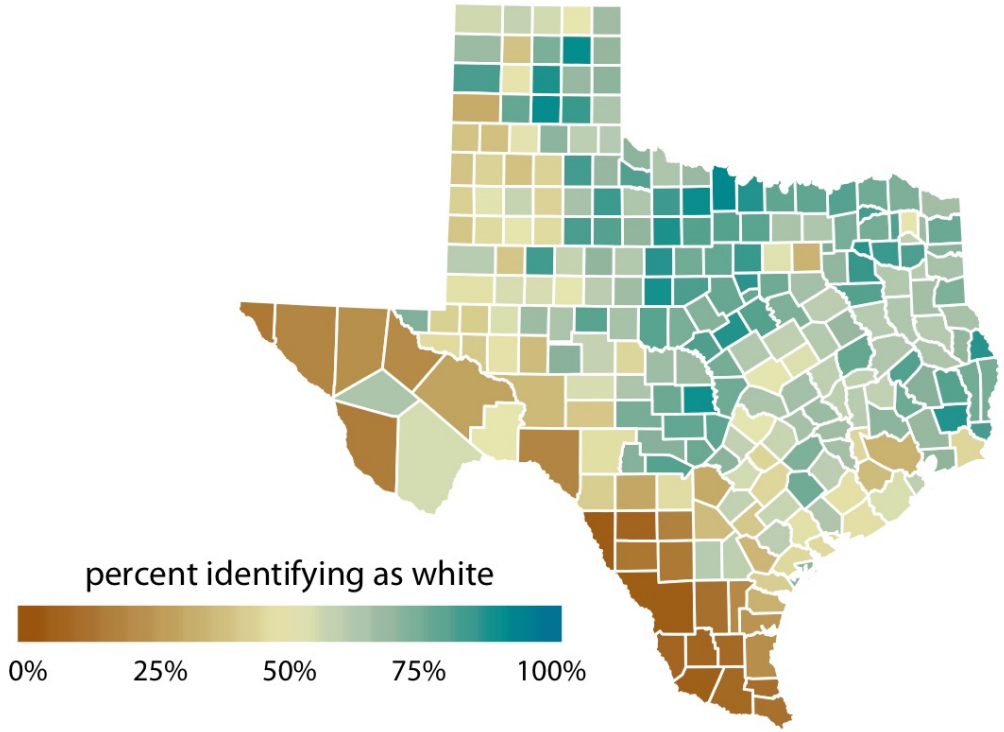


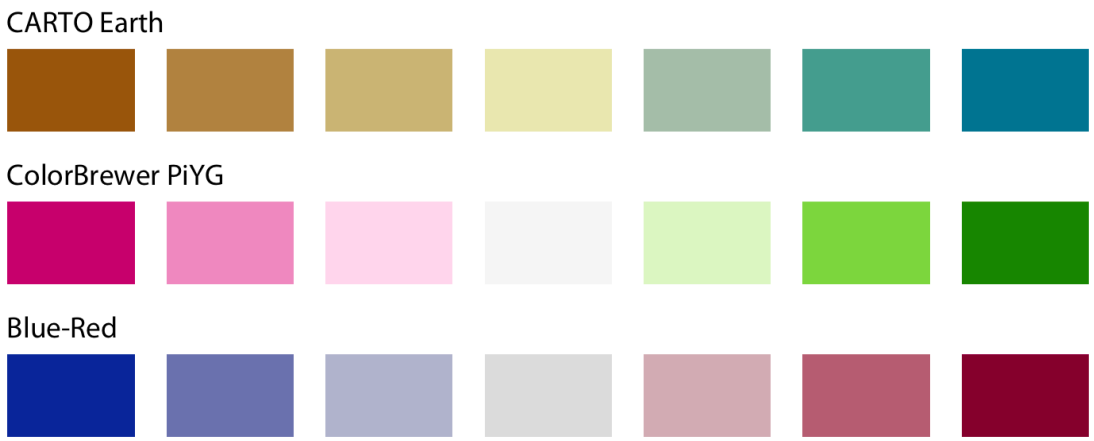


COLOR SCHEME EXAMPLE (SEQUENTIAL)

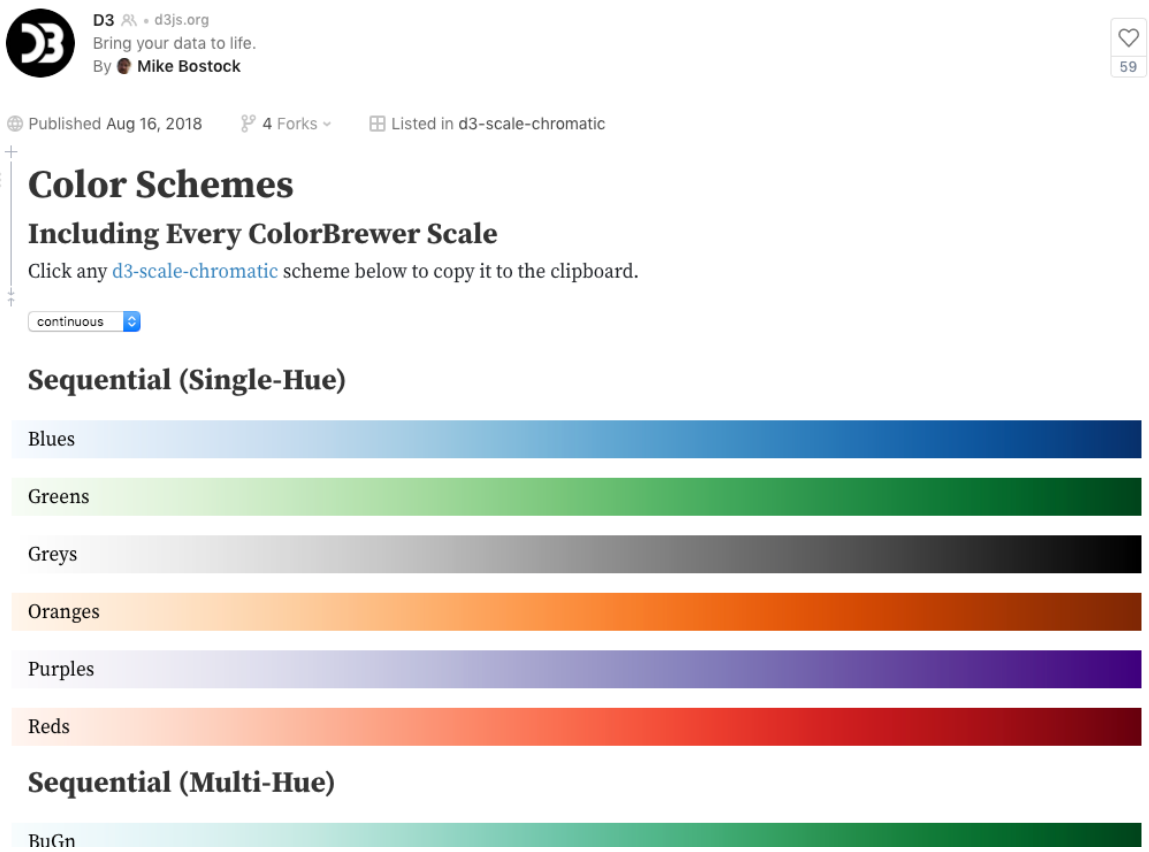


COLOR SCHEME EXAMPLE (DIVERGENT)





D3.JS COLOR SCHEMES



https://observablehq.com/@d3/color-schemes

TAKEAWAY MESSAGES

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