

Working with Colors and Images in CSS

UNDERSTANDING COLORS ON THE WEB



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Moving Ahead

How we, as human beings...

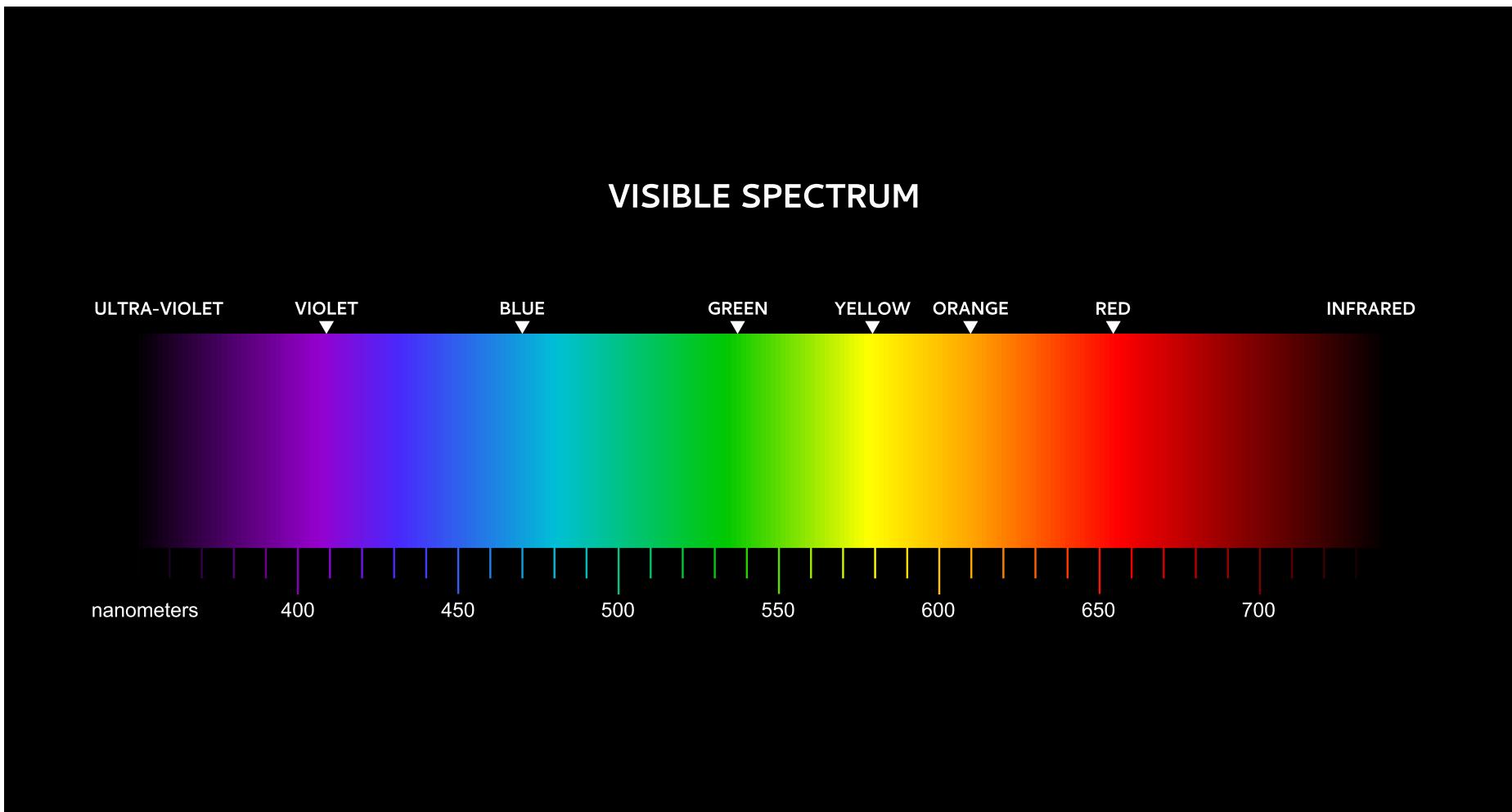
Describe the nature of color

And how graphic designers do

And how we can speak their language



The Physics of Colors and Images



Why This Is Called the Visible Range



It's visible because we can see it



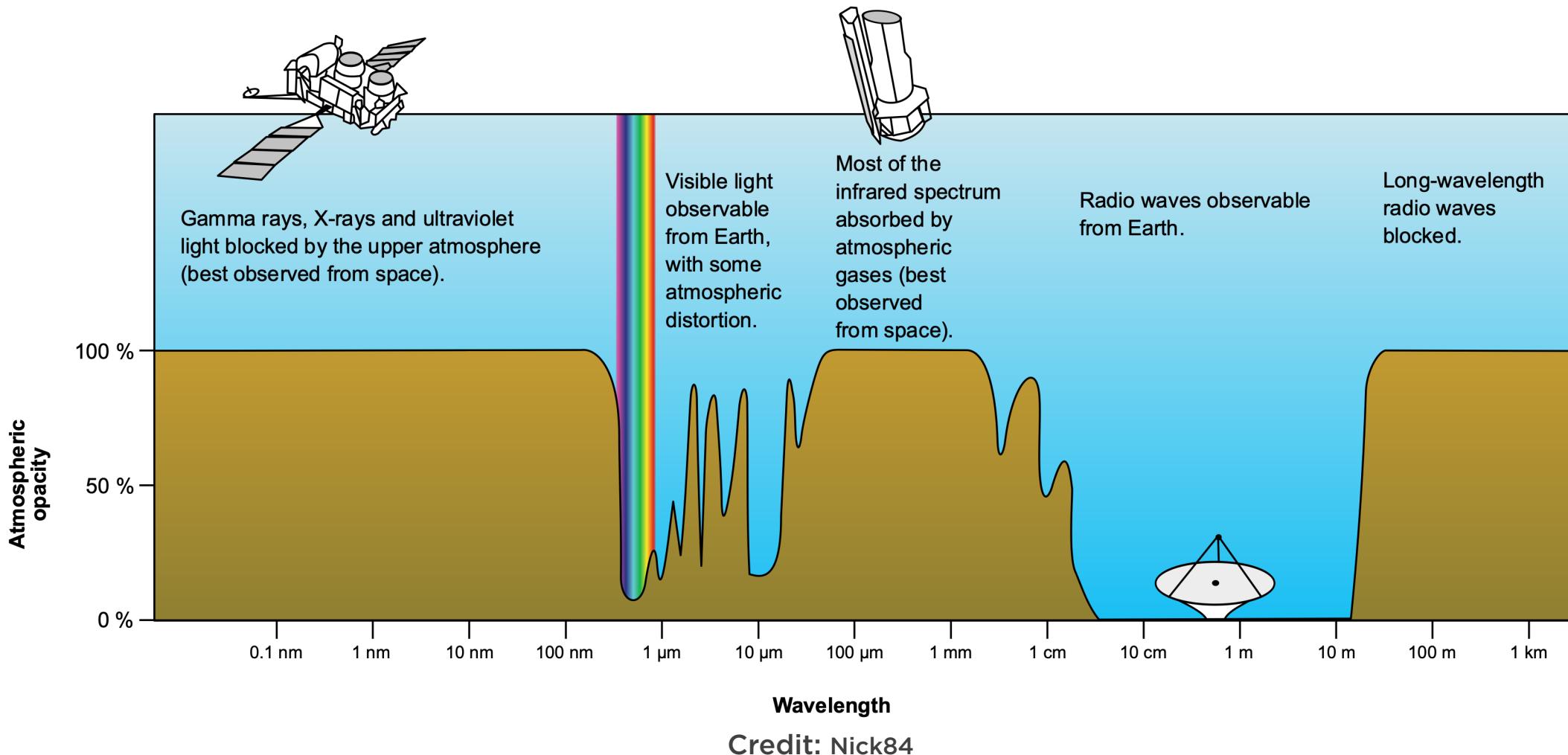
Physics doesn't know this range is special



Most living creatures share this visible range



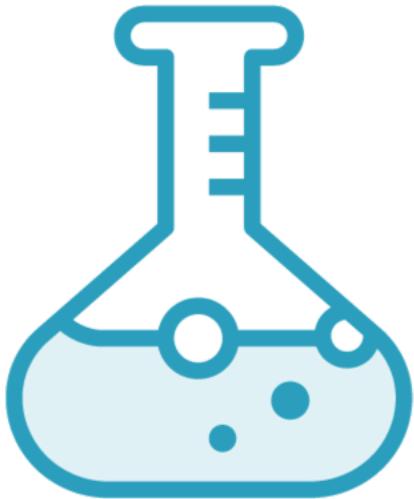
EM Absorption in the Earth's Atmosphere



Alien Light and Alien Life



The absorption
characteristics of the
Earth's atmosphere



78% Nitrogen, 21%
Oxygen



Aliens might see
different colors



The Biology of Color and Light

The sun is the transmitter

Our eyes are the receivers

Rods, best for low light levels

**Cones, best for mid to high
light levels**



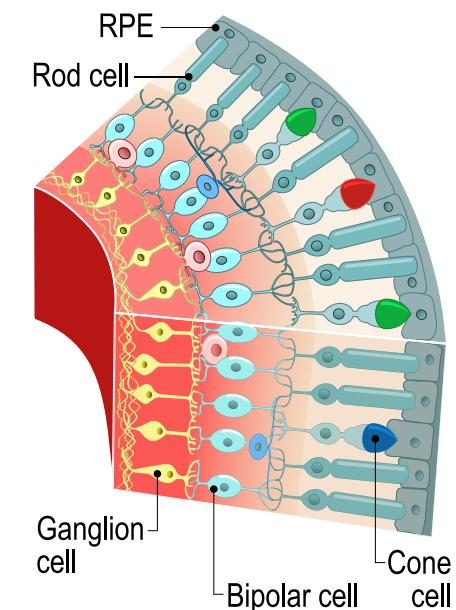
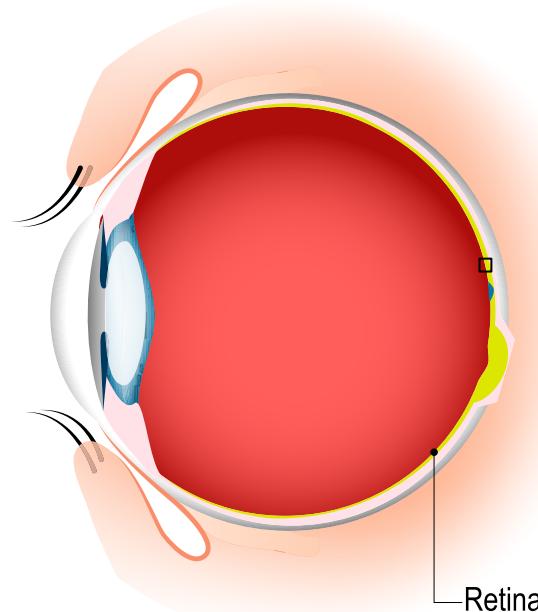
Rods are concentrated on the outer edges

Cones are in the middle

Astronomers use this with *averted vision*

The rods at the edges better detect the fainter light

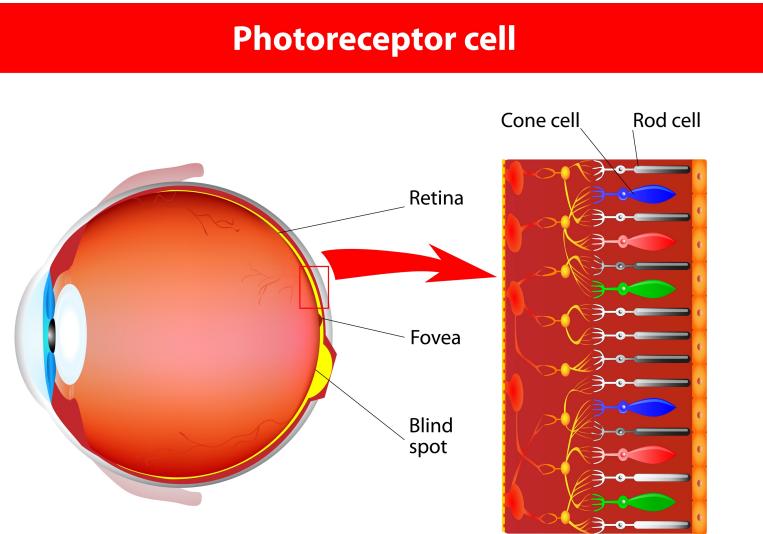
Eye anatomy



SECTION OF RETINA



How We Perceive Color



Color is perceived primarily by the cones

Long – red

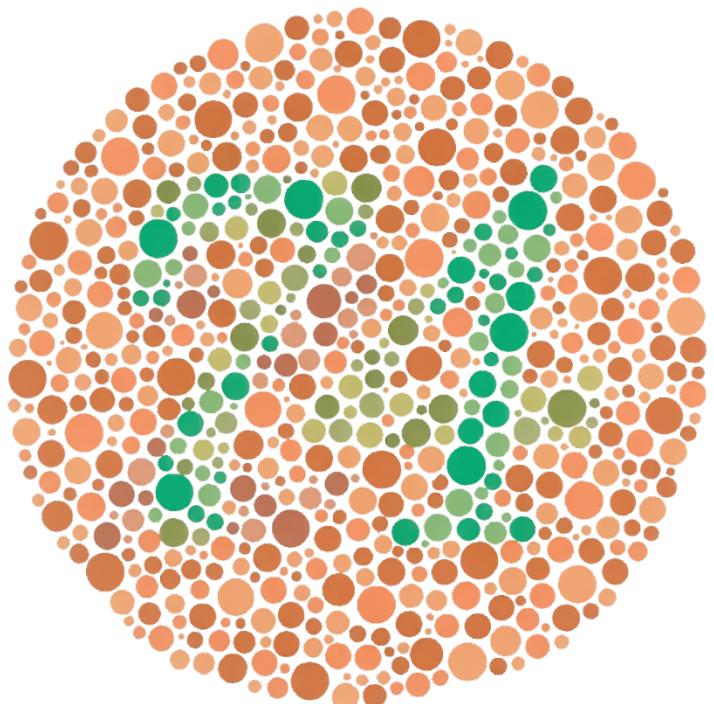
Medium – green

Short – blue

Vision is trichromatic – “three-colored”



Anomalous Color Perception



8% of the male population is dichromatic

Protanopia – poor red perception

Deutanopia – poor green perception

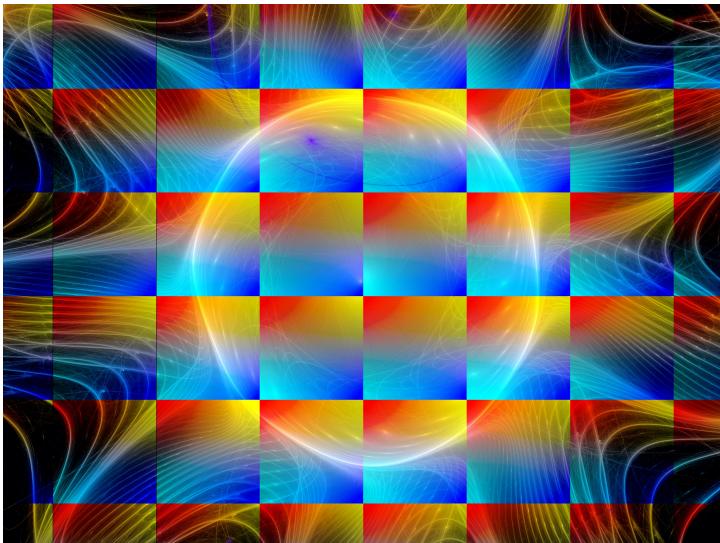
Normal vision sees a 74 in the image to the left

Tritanopia – poor blue perception...very rare

Achromacy – true color blindness...< .005%



Tetrachromacy



People who need four colors

Tetrachromats

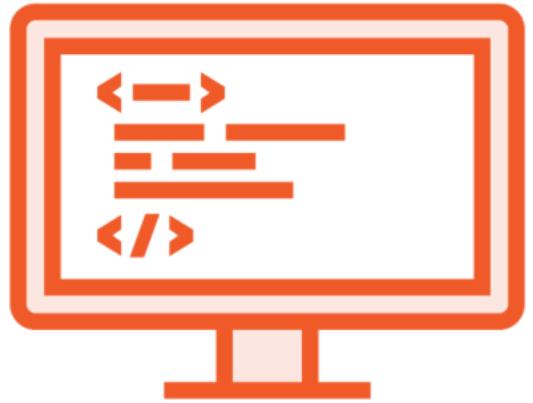
All female

**Possibly 12% of the female population have
the right genes**

Why so few tetrachromats? We're not sure



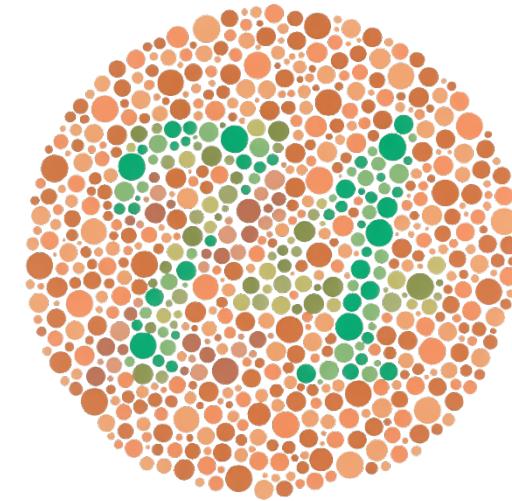
The Color Perception of Your Users



**The work you will
create**



**Problems with color
perception are
common enough for
you to think about
them**



**Remember the Ishara
test**



“Color itself is subtle and exacting...the viewer’s mind is beset by uncertainties and complexities. These translations are...often noisy and idiosyncratic with plenty of differences in perception found among viewers.”

Edward Tufte, Envisioning Information



Don't represent information
solely with color.



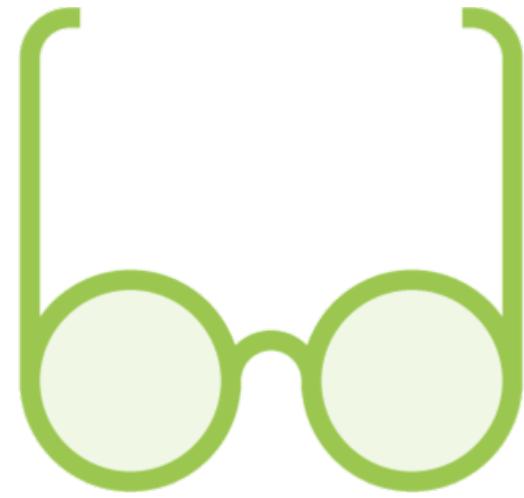
Representing Information Multimodally



A heart monitor



An auditory alarm



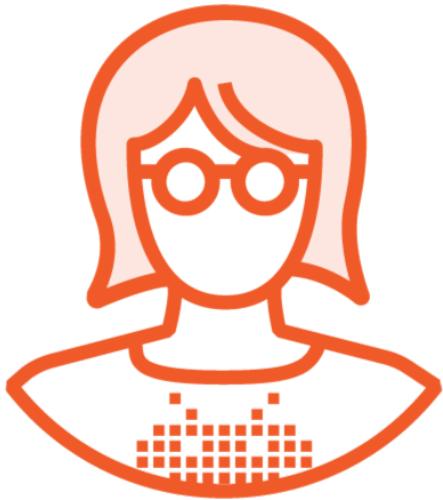
“Note all the terms
below in red”

<https://webaim.org/articles/visual/colorblind>

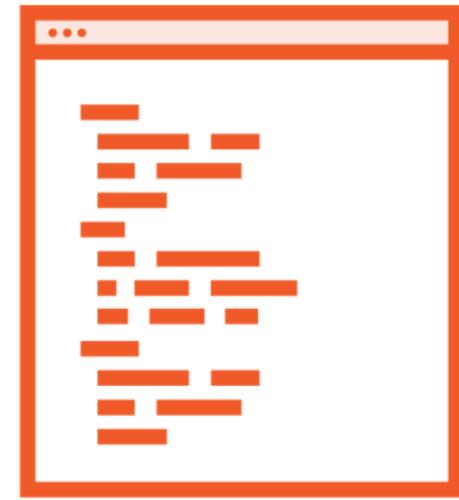
<https://www.toptal.com/designers/colorfilter>



Different Ways to Denote Color



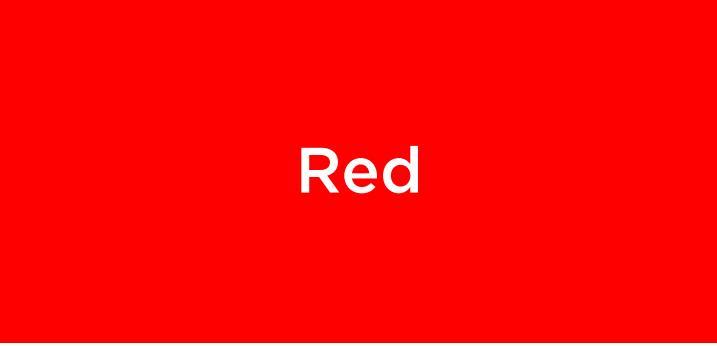
The ways that we, as technologists,
represent colors



With names: “red”, “green”, “blue”



Denoting Color with Language



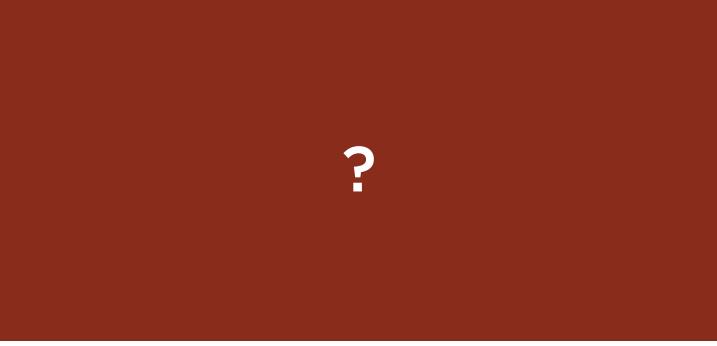
Red



Blue



Green



?



Goldenrod



Dark Yellow



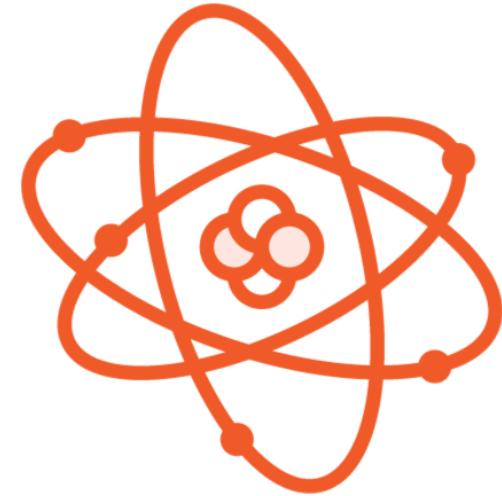
The Problem with Color Names



Goldenwhat?



The color names are
lore - a bad thing



We want to do science
instead



The Web-Safe Palette



Color names are mostly avoided nowadays

**The web-safe color palette – 216 colors
which could be represented undithered on
older displays**

**Today, nearly everything can display all
colors**



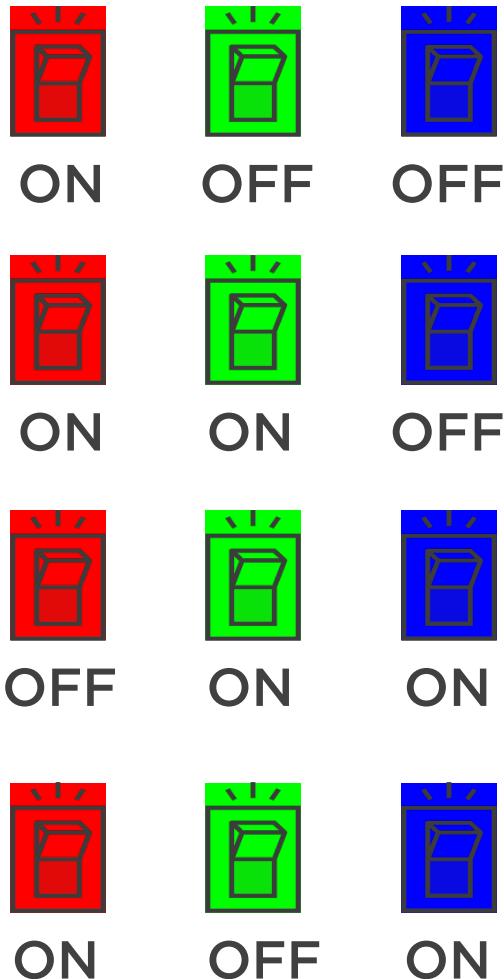
RGB

**Color names are useful mostly
for black and white**

**The human eye has three
cones, blue, green, and red**



Building Colors in RGB



Red	Green	Blue	Result
On	Off	Off	Red
Off	On	Off	Green
Off	Off	On	Blue
On	On	Off	Yellow
On	On	On	Cyan
On	Off	On	Purple
On	On	On	White
Off	Off	Off	Black



Introducing Dimmer Switches

Dimmer switches
allow intermediate
values between
off and on

Darker red

127, 0, 0

Bluish-purple

127, 0, 256



How Many Colors?

256 * 256 * 256

=

16,777,216

All visible colors



Hex Codes

Columns on the paper can only hold two digits

0 - 256

Decimal can only denote 0-99

Hexadecimal
(sixteen) system

FF = 256
 (16×16)



Colors in Hex Codes



Red = FF0000

Darker red = 7F0000

Blue = 0000FF

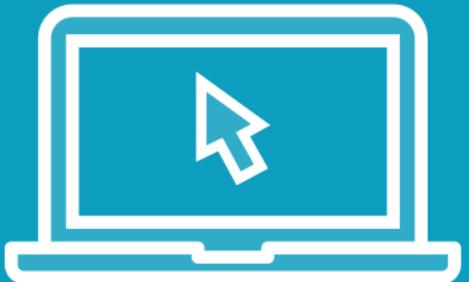
I have to learn to do this in my head?!?

Nope, let a “hex code converter” or “online color picker” do it for you

All that matters is that you understand what it’s converting and picking



Demo



Take an existing HTML page

Review it in a browser

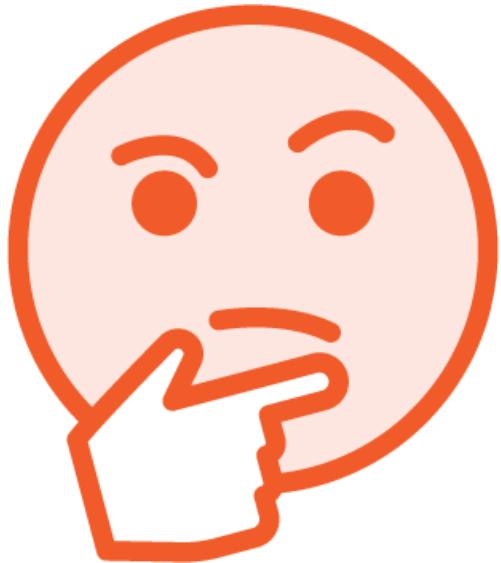
Make some simple color changes

- Using hex codes

Review the results



Other Ways to Represent Colors



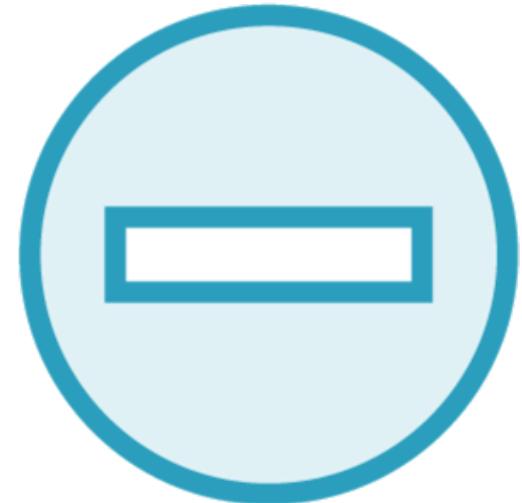
I thought yellow
and blue make
green...



A different
model than the
one we learned



Adding light to
black



Subtracting
light from white



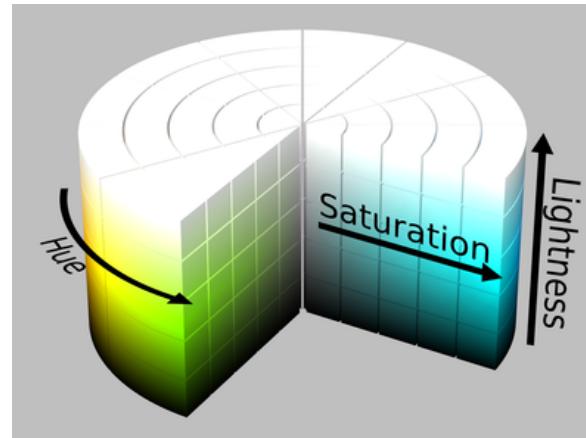
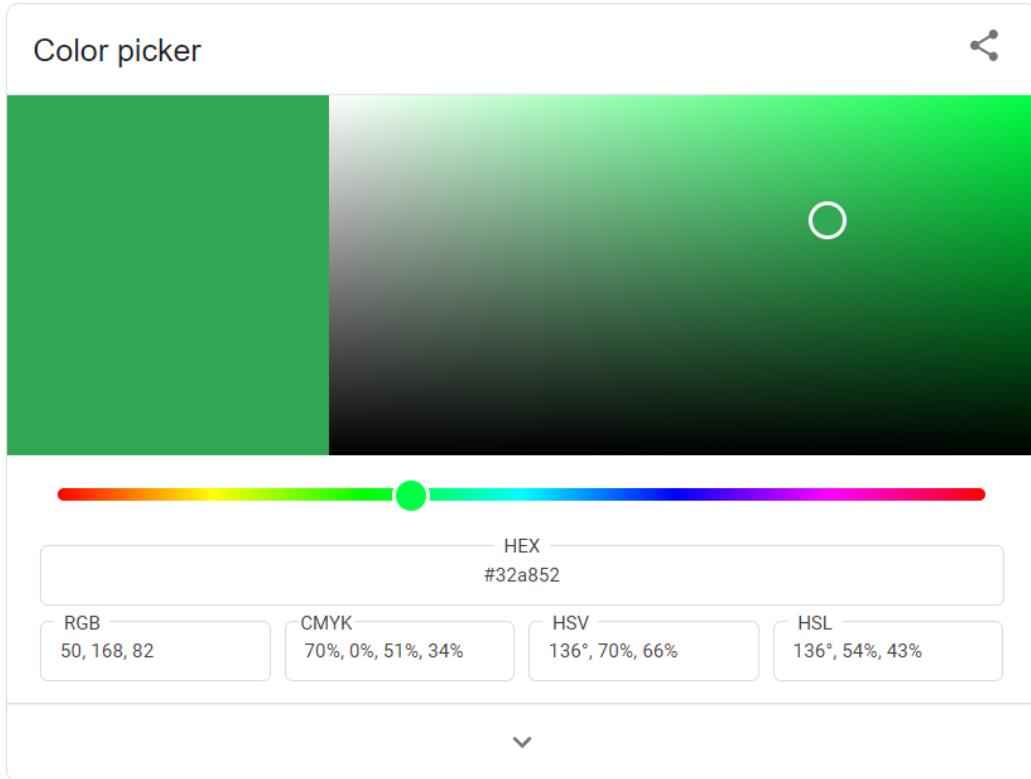
Cyan, Magenta, Yellow, and Black



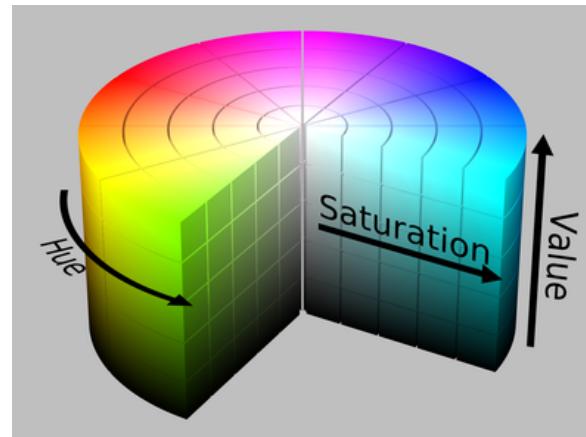
**CMYK is widely used in printing
Starting with white
Hues on paper don't emit light, they only
reflect them**



The Hue and Saturation Models



Credit for both images: SharkD



Pantone

A company in New Jersey

The Panton Color Matching System

Pantone codes

171 CP



Summary



The physics of colors

- With a little bit of sci-fi thrown in
- To root this stuff in your imagination

The biology of color perception

- How it works
- The implications
 - for accessibility
 - For users with different color perception

Different ways to represent colors

- RGB
- CYMK
- HSL
- HSV
- Pantone

