

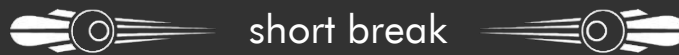
image analysis



CS148 / 26 june 2014

1

Color, color, color!



short break

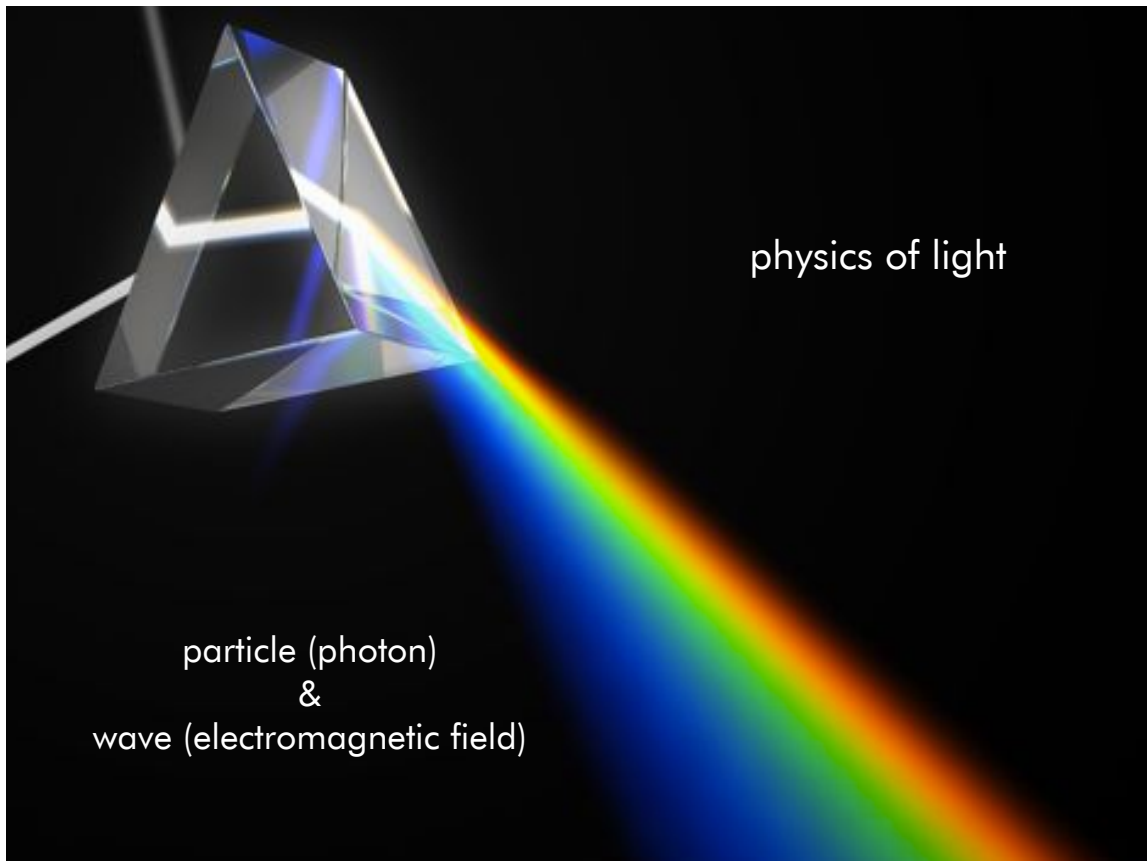
Structure and form

Practice: image breakdown

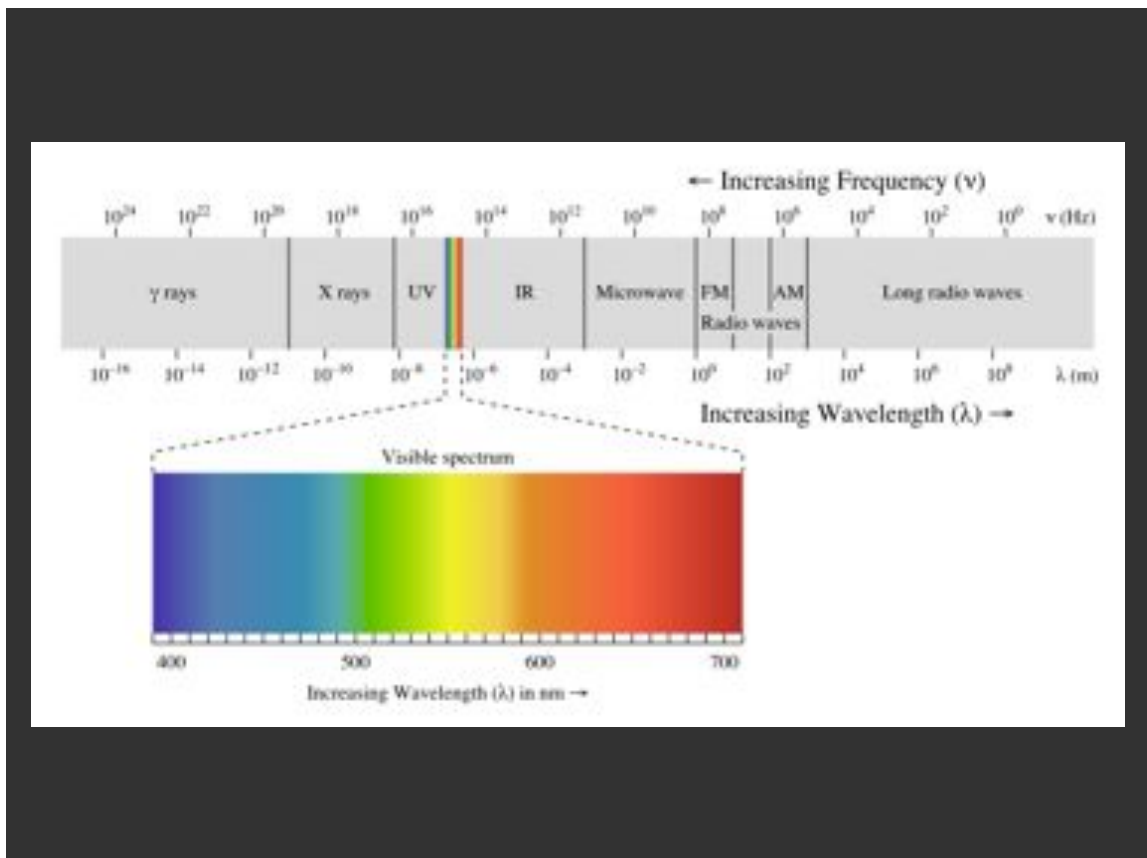
When pixels attack

Wrap up

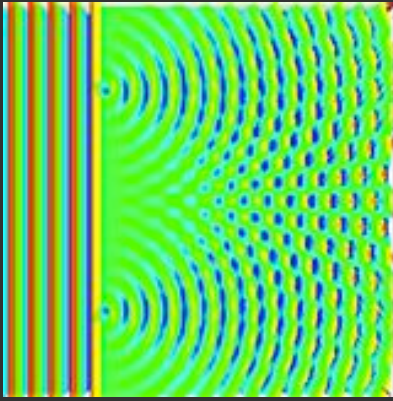
2



3



4



graphics:
simplified model of light

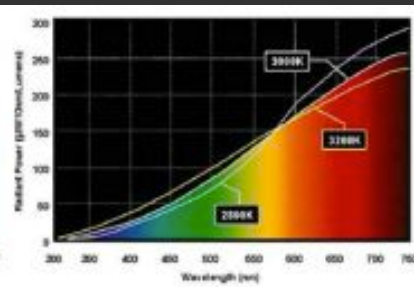
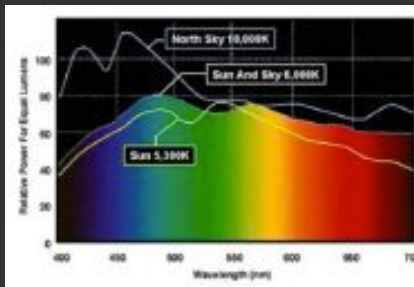


5

spectral power distribution of lights

outdoor

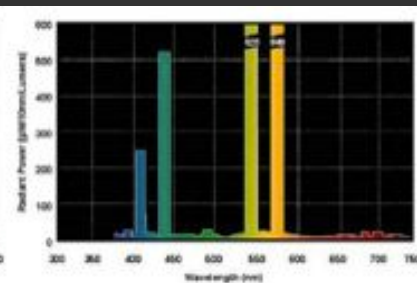
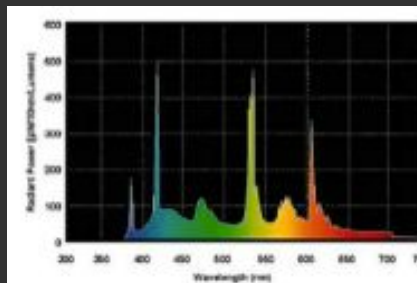
incandescent



SP65 triphosphor fluorescent

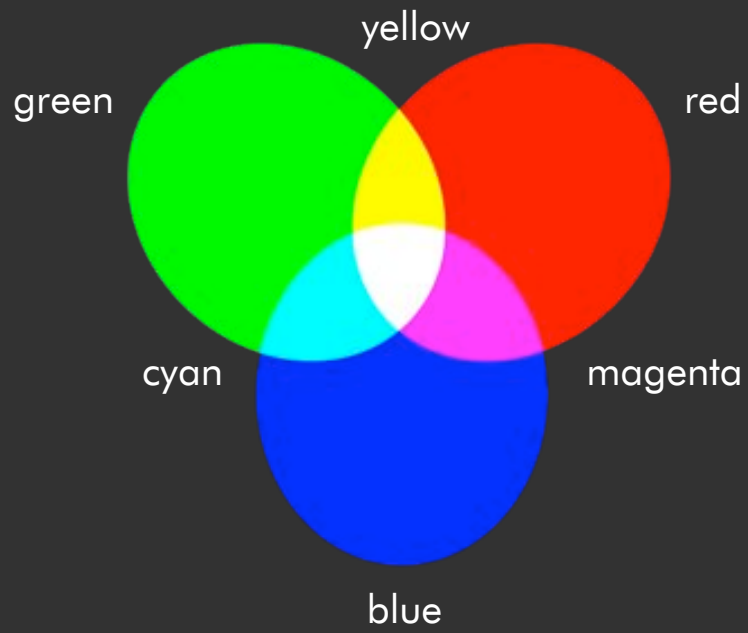
mercury lamp

source:
general electric



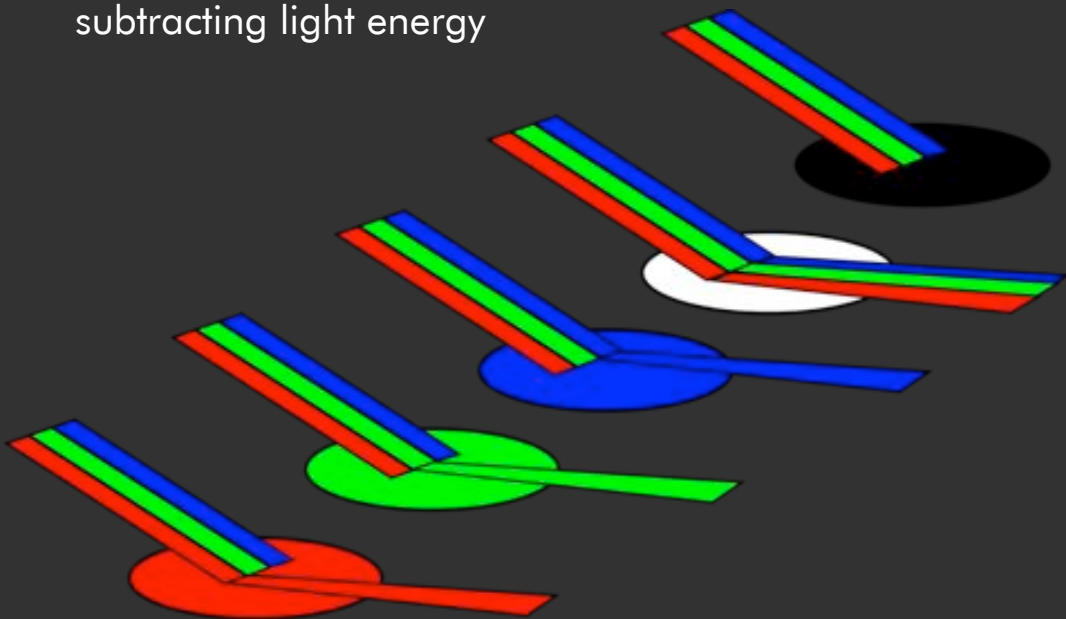
6

adding light energy



7

subtracting light energy



shining white light on various colored pigments

8

measuring light



9

measuring light

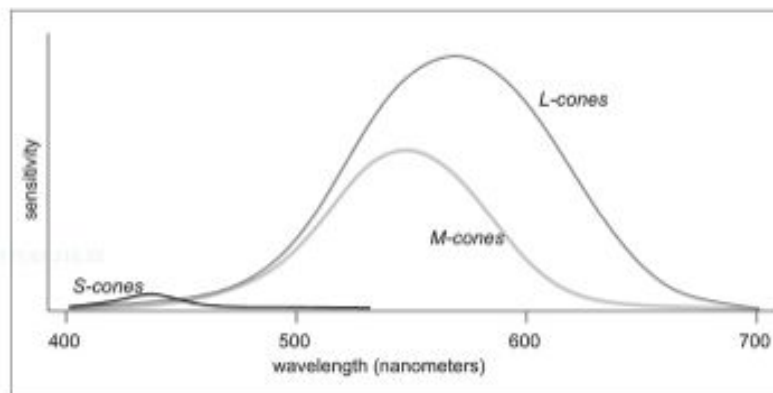
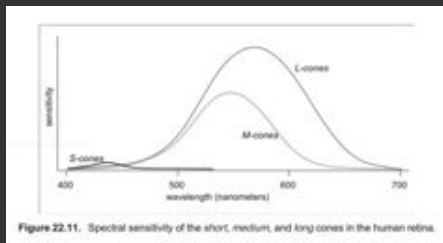


Figure 22.11. Spectral sensitivity of the *short*, *medium*, and *long* cones in the human retina.

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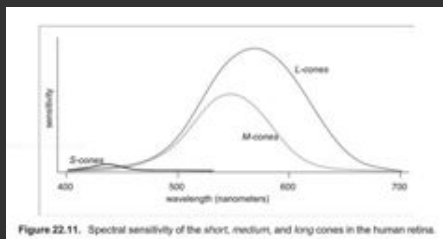
measuring light

$$R \propto \int R(\lambda)E(\lambda)d\lambda$$

$$\begin{aligned} R_L &\gg R_M, R_S \\ R_L &\approx R_M, \gg R_S \\ R_M &\gg R_L, R_S \\ R_S &\gg R_M, R_L \\ R_S &\approx R_M \approx R_L \end{aligned}$$



11



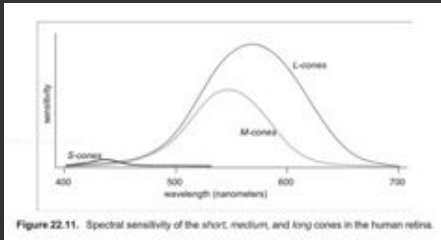
measuring light

$$R \propto \int R(\lambda)E(\lambda)d\lambda$$

$$\begin{aligned} R_L &\gg R_M, R_S \\ R_L &\approx R_M, \gg R_S \\ R_M &\gg R_L, R_S \\ R_S &\gg R_M, R_L \\ R_S &\approx R_M \approx R_L \end{aligned}$$



12



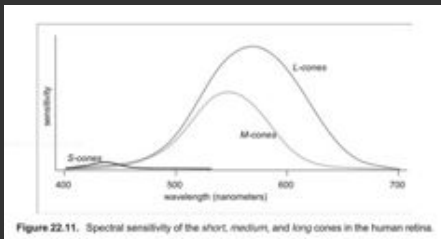
measuring light

$$R \propto \int R(\lambda)E(\lambda)d\lambda$$

$$\begin{aligned} R_L &\gg R_M, R_S \\ R_L &\approx R_M, \gg R_S \\ R_M &\gg R_L, R_S \\ R_S &\gg R_M, R_L \\ R_S &\approx R_M \approx R_L \end{aligned}$$



13



measuring light

$$R \propto \int R(\lambda)E(\lambda)d\lambda$$

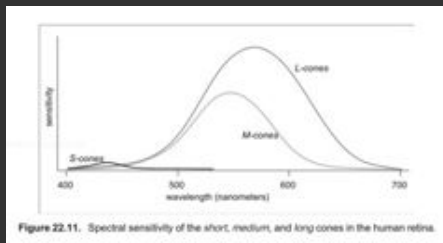
$$\begin{aligned} R_L &\gg R_M, R_S \\ R_L &\approx R_M, \gg R_S \\ R_M &\gg R_L, R_S \\ R_S &\gg R_M, R_L \\ R_S &\approx R_M \approx R_L \end{aligned}$$



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measuring light



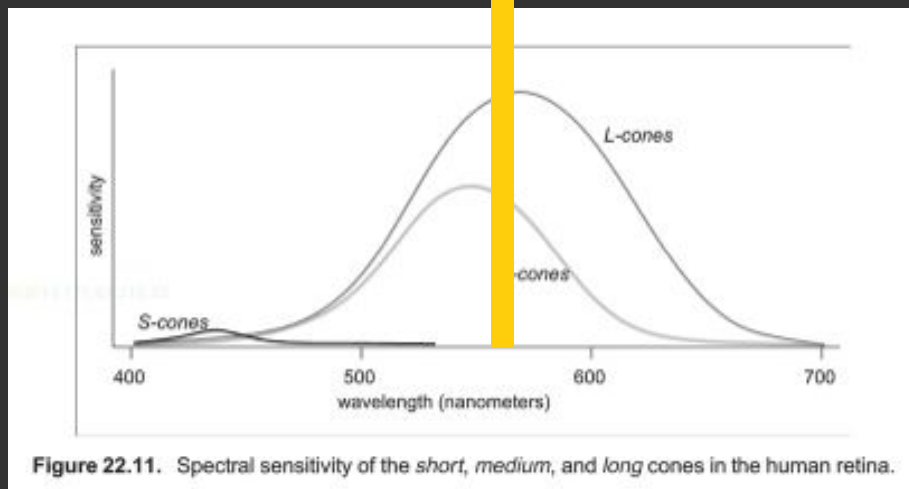
$$R \propto \int R(\lambda)E(\lambda)d\lambda$$

$$\begin{aligned} R_L &\gg R_M, R_S \\ R_L &\approx R_M, \gg R_S \\ R_M &\gg R_L, R_S \\ R_S &\gg R_M, R_L \\ R_S &\approx R_M \approx R_L \end{aligned}$$



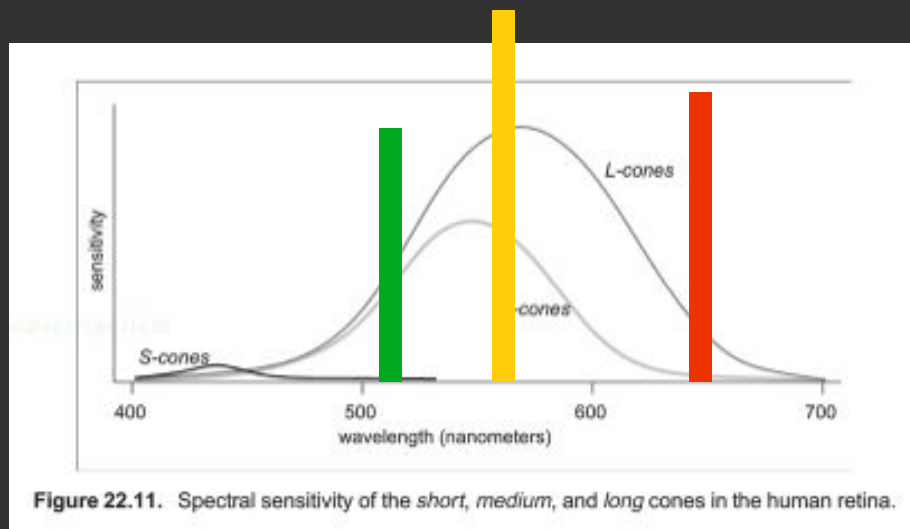
15

measuring light



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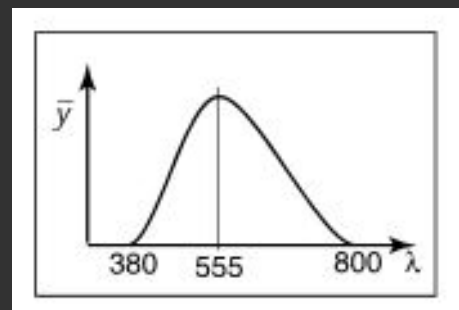
measuring light



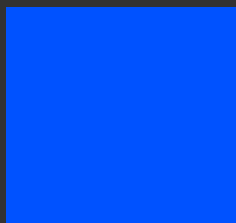
metamerism: different spectra, same color

17

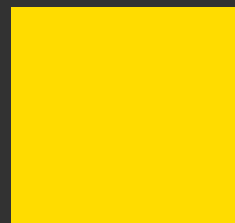
humans are not equally
sensitive to all
wavelengths of light!



420nm



450nm



590nm



620nm

18

(perceived) contrast is a difference in luminance
(perceived) luminance is a function of color

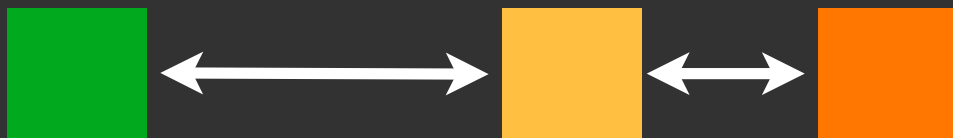


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color spaces

mathematical model mapping
colors to tuples in some abstract space

if continuous, provides a way to represent
distances between colors (i.e., defines a metric)



if the computed (euclidean) distance between two colors
corresponds to the perceptual difference between those colors,
the space is called *perceptually uniform*

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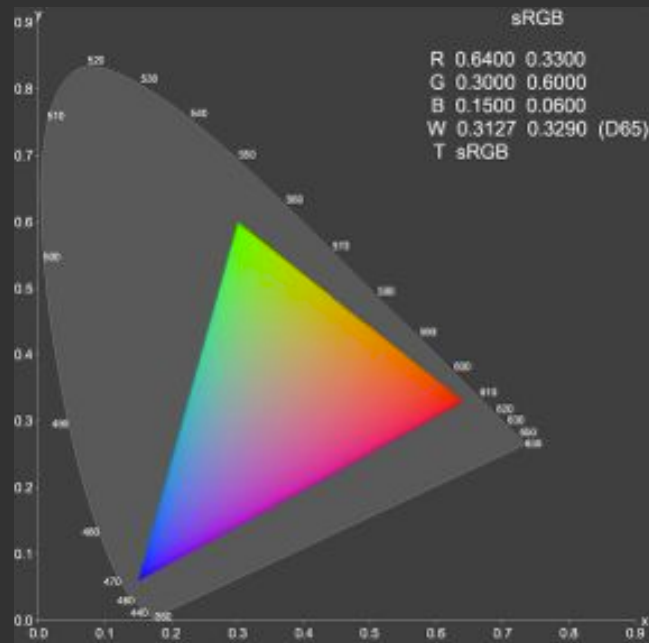
color spaces

RGB

common, convenient

limited gamut

not perceptually uniform



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color spaces

Pantone (1960s - present)

proprietary color matching system
(textiles, plastics, ...)

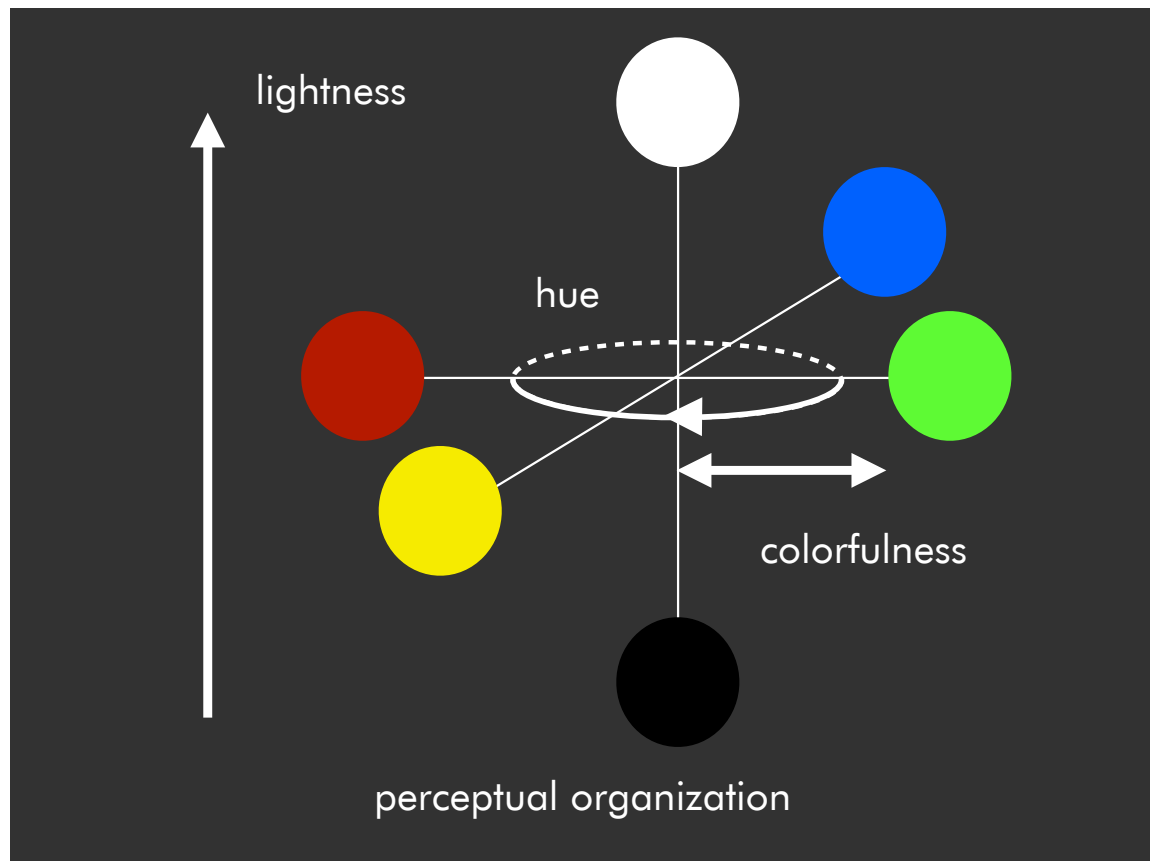
hand curated, 13 base pigments

"color of the year"

logos, product design...



22



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HSV (Hue, Saturation, Value)

"cylindrical" color space
commonly found in color pickers
not perceptually uniform.

The diagram shows a 3D cylindrical model of the HSV color space. The top edge of the cylinder is a color wheel labeled "hue". The vertical axis is labeled "value", and the radial distance from the center is labeled "saturation". Below this, two 2D color picker interfaces are shown. Each interface consists of a circular hue wheel and a square value/saturation gradient. The left picker shows a magenta color selected, with the text "Color: #ff00ff" below it. The right picker shows a green color selected, with the text "Color: #00ff00" below it.

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perceptual color spaces

Munsell (c. 1900)

Based on extensive field work.

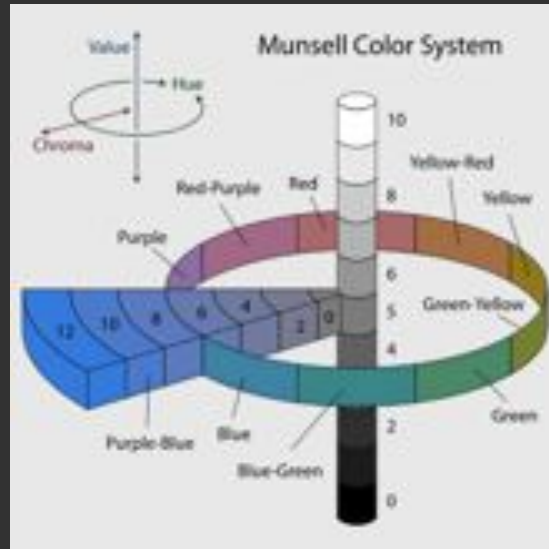
hue (6 primaries)

chroma (from gray to saturated)

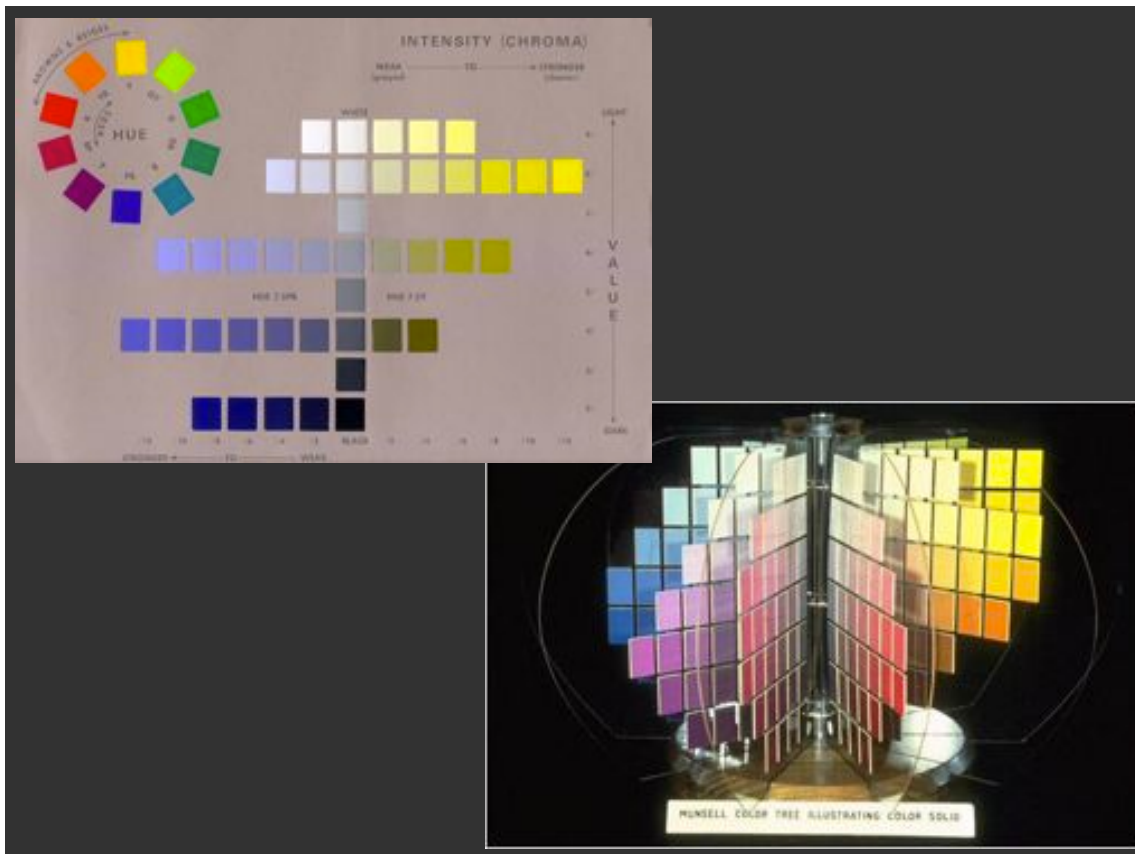
value (amount of white/black)

Discrete values

Limitations influenced
development of CIE Lab



25



26

LAB

(CIELab, L^*a^*b , ...)

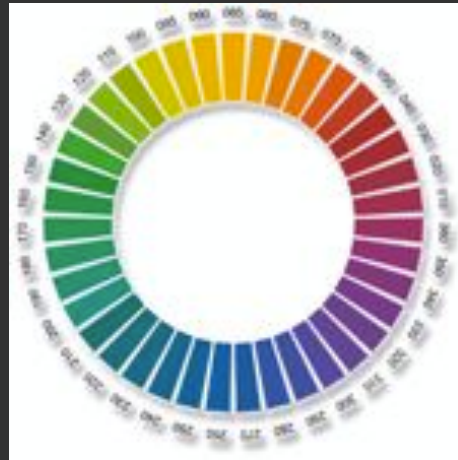
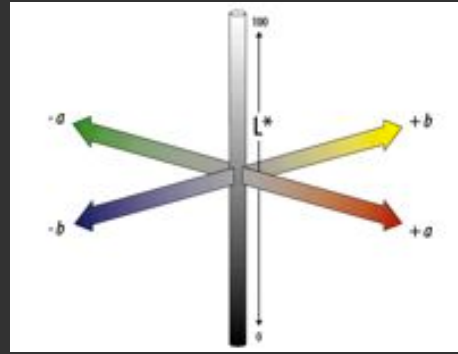
Lightness

a (green : magenta)

b (blue : yellow)

Euclidean distance designed to
match perceptual distances

very useful in graphics
applications!



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color space	continuous?	perceptually uniform?
RGB	✓	✗
HSV	✓	✗
LAB	✓	✓
Munsell	✗	✓
Pantone	✗	✗

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and that's not all!

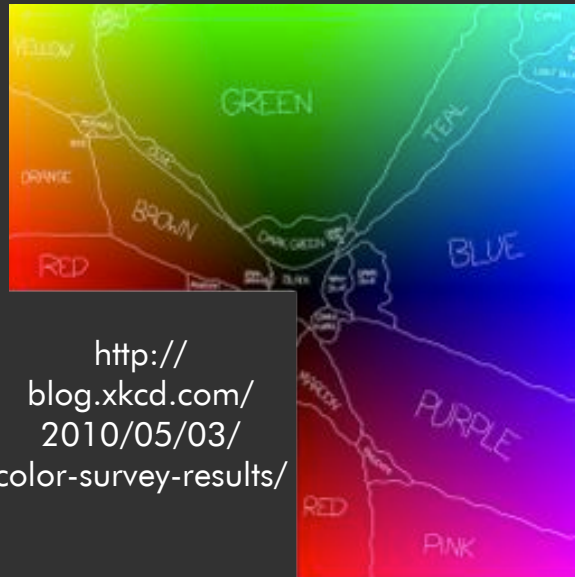
color naming

culture

gender

language

...



29

and that's not all!



van gogh

30

and that's not all!

palette extraction



31



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elements of art

lines, shape
size
color, value
texture
media

contours, surfaces
aspect ratio
palette
artificial textures
simulated materials

principles of art

harmony, unity
balance
proportion
dominance, emphasis
repetition, rhythm

composition/
layout

33

texture



"impasto" technique



lucian freud

34

texture



edward weston

35

color palette



bret steinhaus, watercolor

36

Text

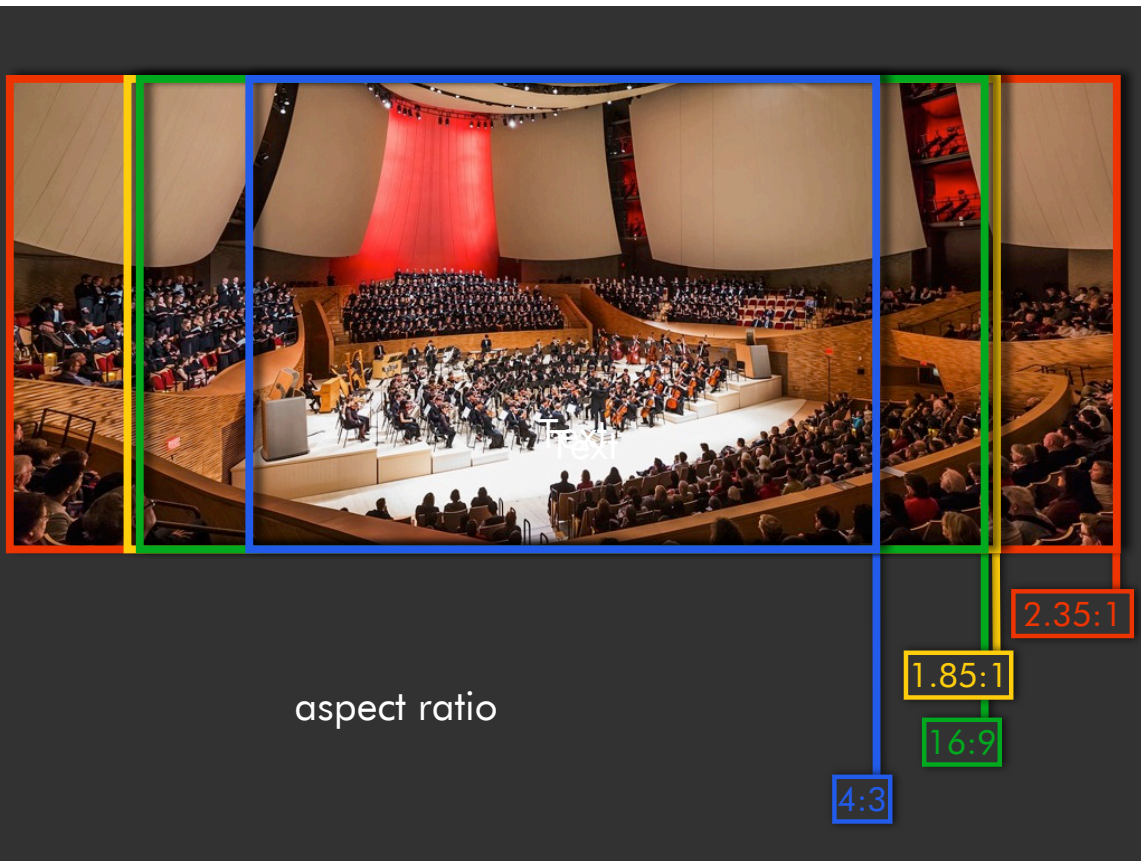
aspect ratio

4:3

1.85:1

16:9


2.35:1



37

aspect ratio

georgia o'keefe



38

elements of art

lines, shape
size
color, value
texture
media

contours, surfaces
aspect ratio
palette
artificial textures
simulated materials

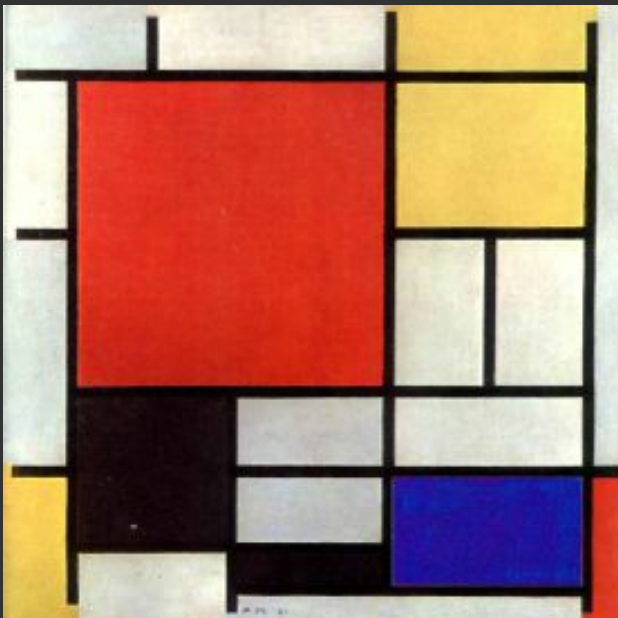
principles of art

harmony, unity
balance
proportion
dominance, emphasis
repetition, rhythm

composition/
layout

39

composition and layout



piet mondrian



40



robert krasker, the third man

41

rule of thirds

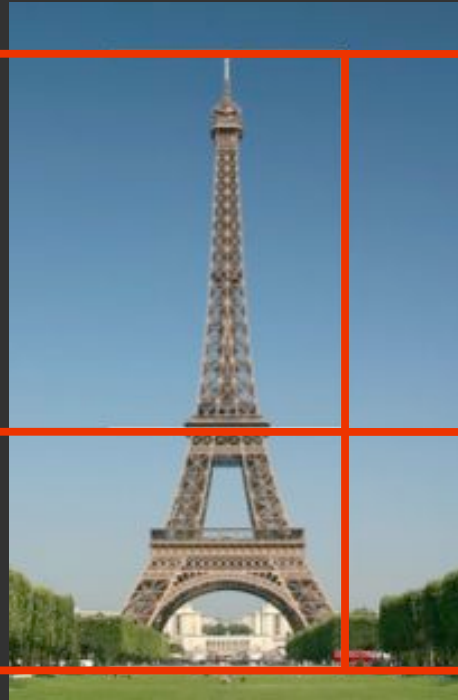
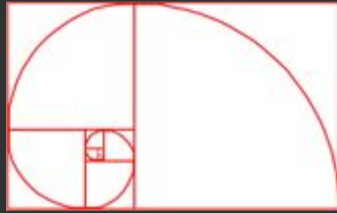


tonino delli colli, the good, the bad, and the ugly

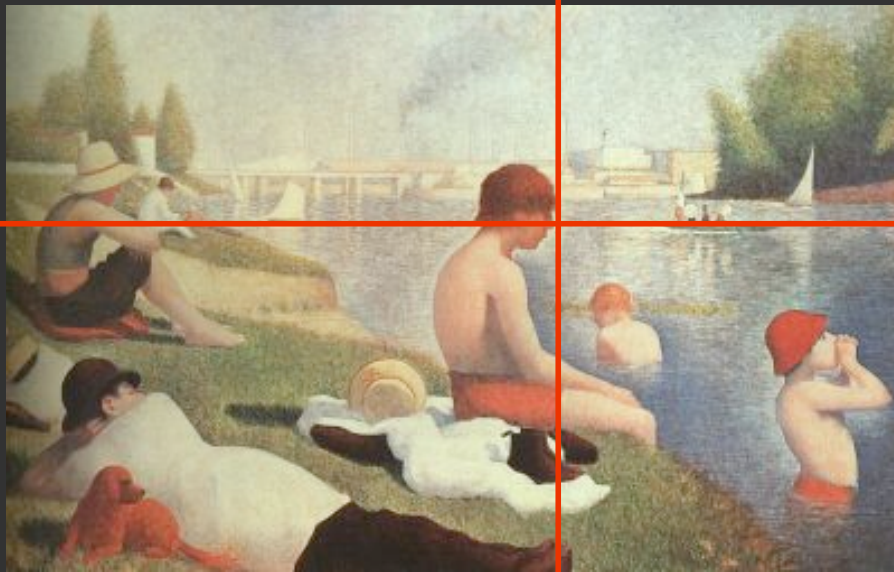
42

golden ratio

$$\frac{a}{b} = \frac{a+b}{a} = \phi = 1.618...$$



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georges seurat

44

perspective

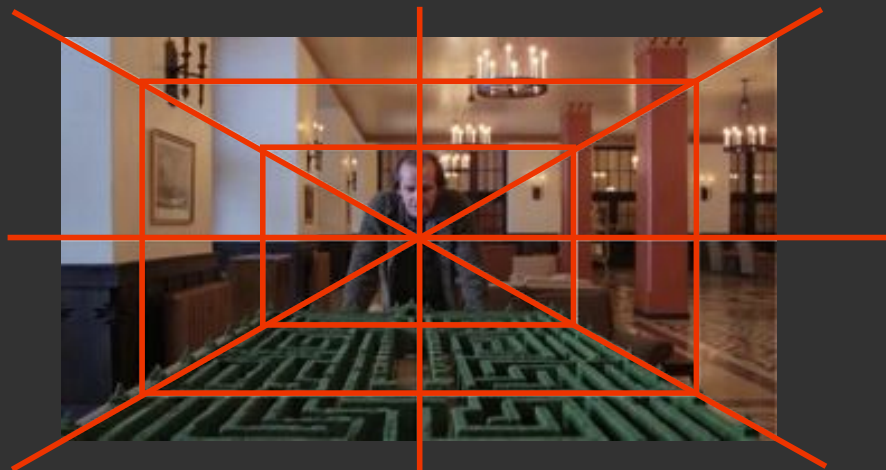


Masolino's "St. Peter Healing a Cripple
and the Raising of Tabitha" (1425)

<http://www.webexhibits.org/sciartperspective/raphaelperspective1.html>

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perspective



john alcott, the shining

46



john alcott, the shining

47



john alcott, the shining

48



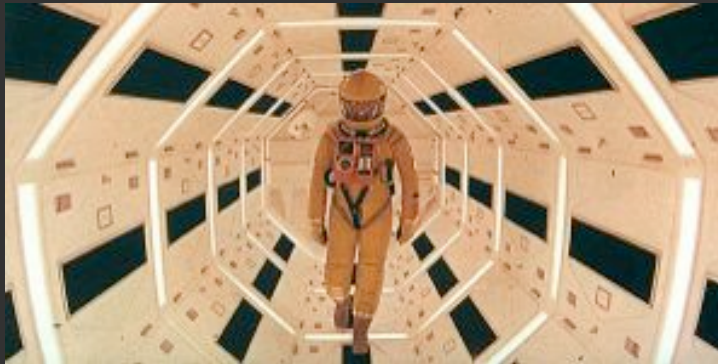
john alcott, the shining

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douglas milsome, full metal jacket

50



geoffrey unsworth, 2001: a space odyssey

51



roger deakins, the company men

52



barry sonnenfeld, miller's crossing

53

Eyeball strength training time!



54

“rendering” media

texture, materials

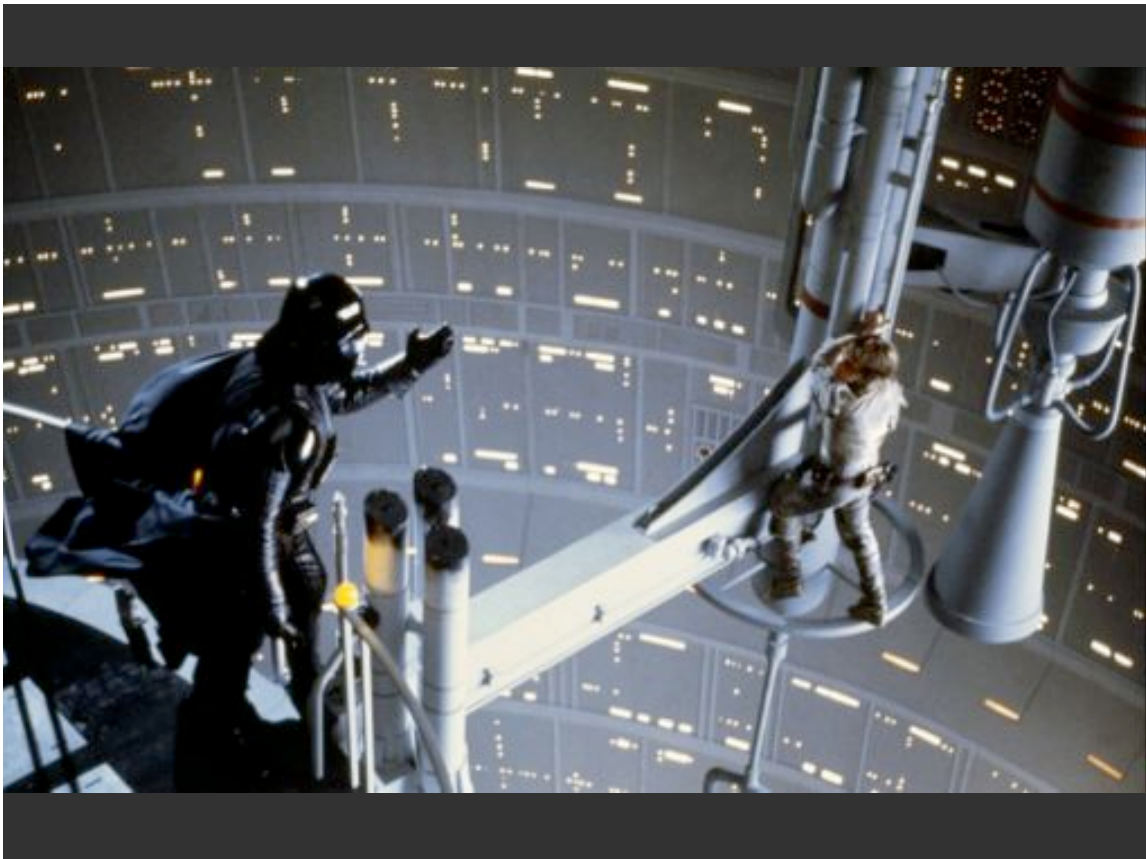
conveying shape

palettes and color choices

emotional impact

...&c.

55



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58

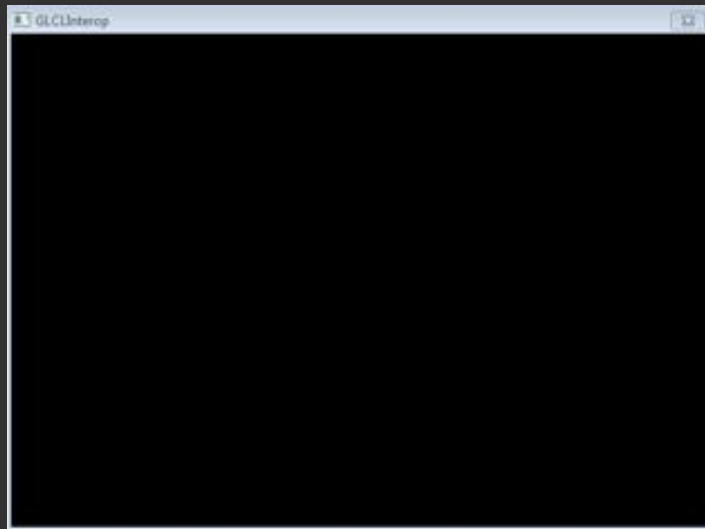


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sometimes things go wrong.



60



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63



64



65



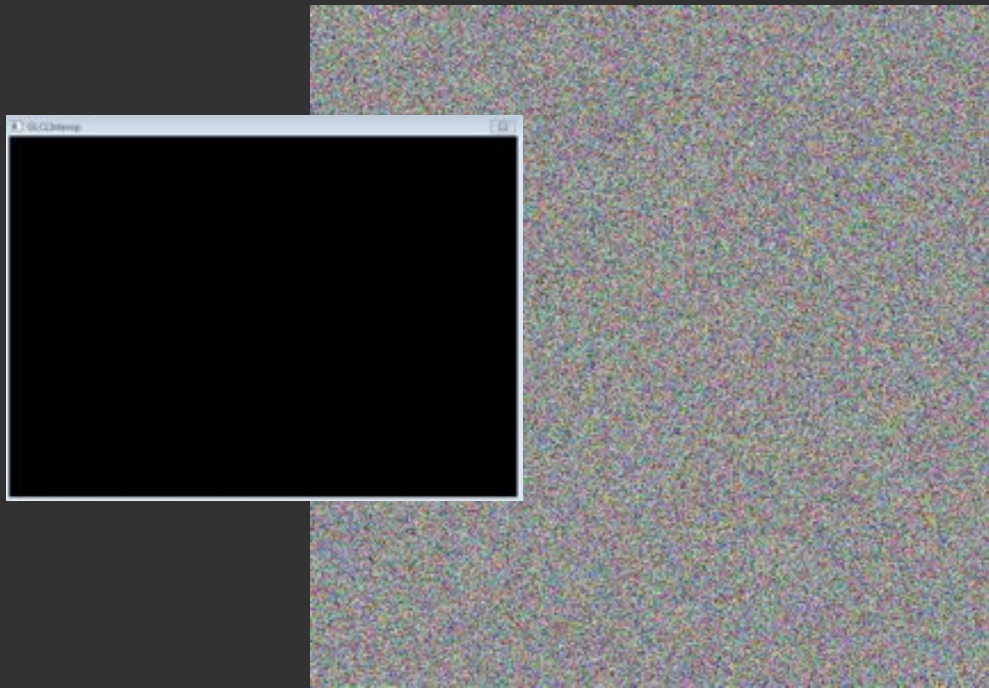
66



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why this matters

perspective, framing, other photographic techniques (week 2)

generating smooth images without aliasing (week 3)

shading and texturing effects (week 4)

communicating surfaces in 3D (week 5)

what makes images realistic looking? (week 6)

stylization effects / reproducing artistic techniques like paint,
watercolor, line drawings... (wk. 7)

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before next time:

Reading response #2 due before class Tuesday
Shirley Ch. 2 pp13-29, Ch. 4: Ray Tracing

Movie screening:
Tim's Vermeer, Wednesday 6pm in Gates 104

Assignment #1 is out!
Note: Cantor is closed Mon/Tues
Due a week from today.

Want to go with a friend?
Connect w/ classmates on Piazza.
Class tour this Saturday from 1-3pm.

Meet me at the Gates of Hell

