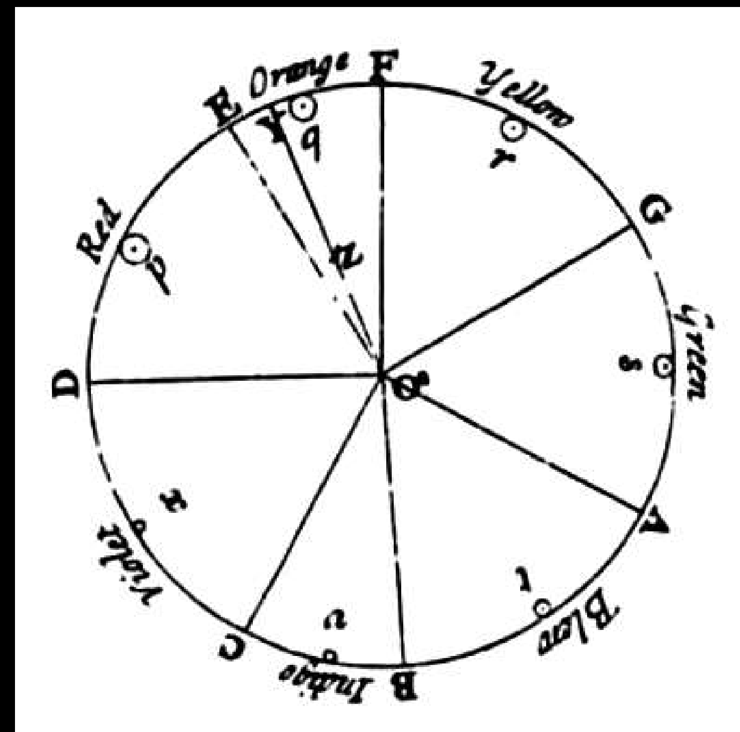
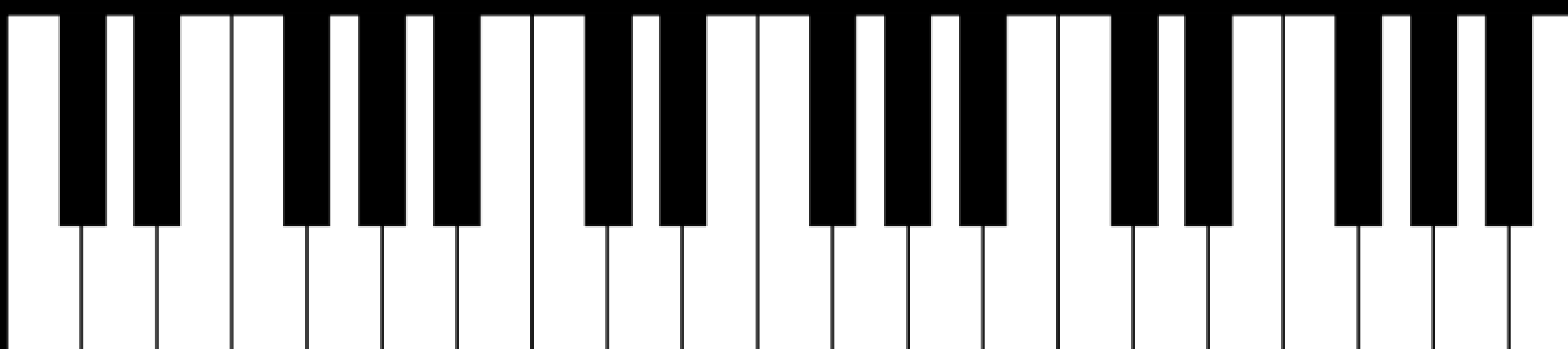
Colour Theories & Some Applications

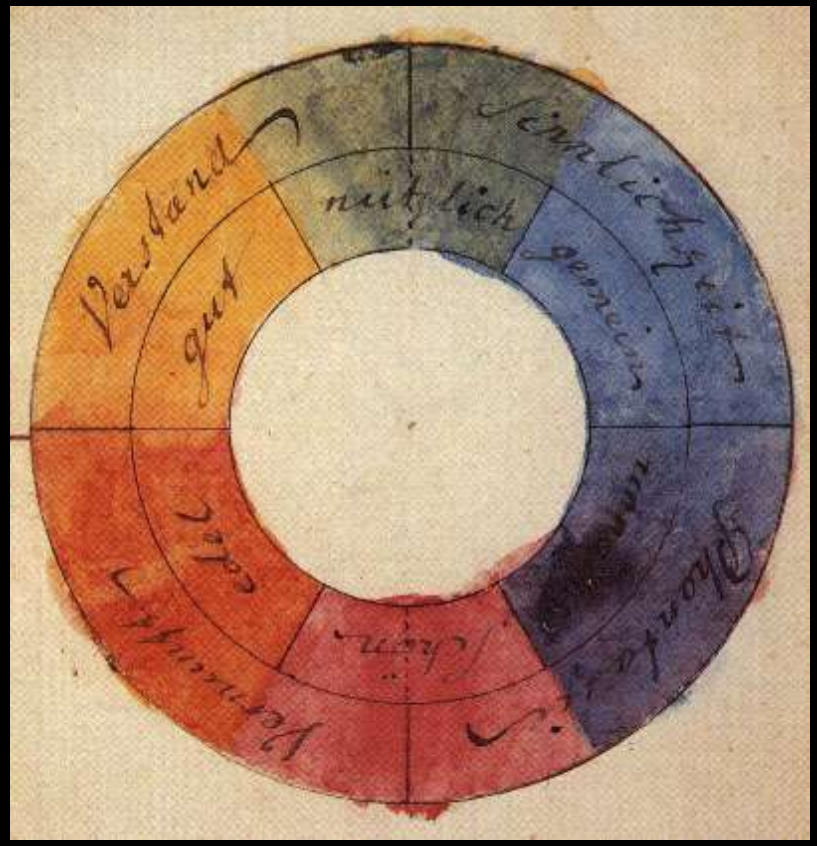
“The purest and most thoughtful minds are those which love color the most.”
— John Ruskin


Orange
F
Yellow
E
G
Red
Green
D
A
Violet
Indigo
B
C



Interpretations of Colour Theory by artists

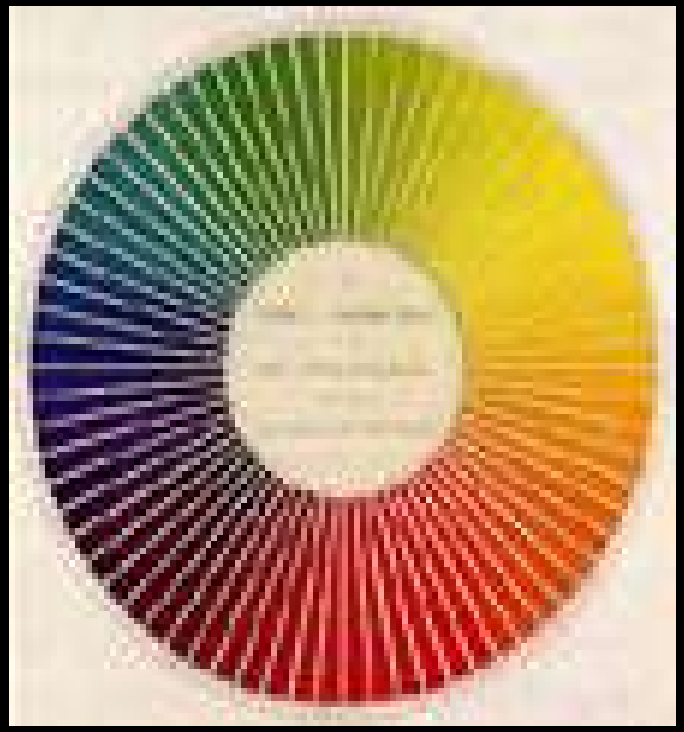
- Goethe's Theory of Colours (1810)
- Built on wavelength theory of light (after Newton)
- Methods interesting
- Conclusion refuted
- Influential on artists
- Ex. Turner
- Colour theory weblink



Goethe's Colour Wheel

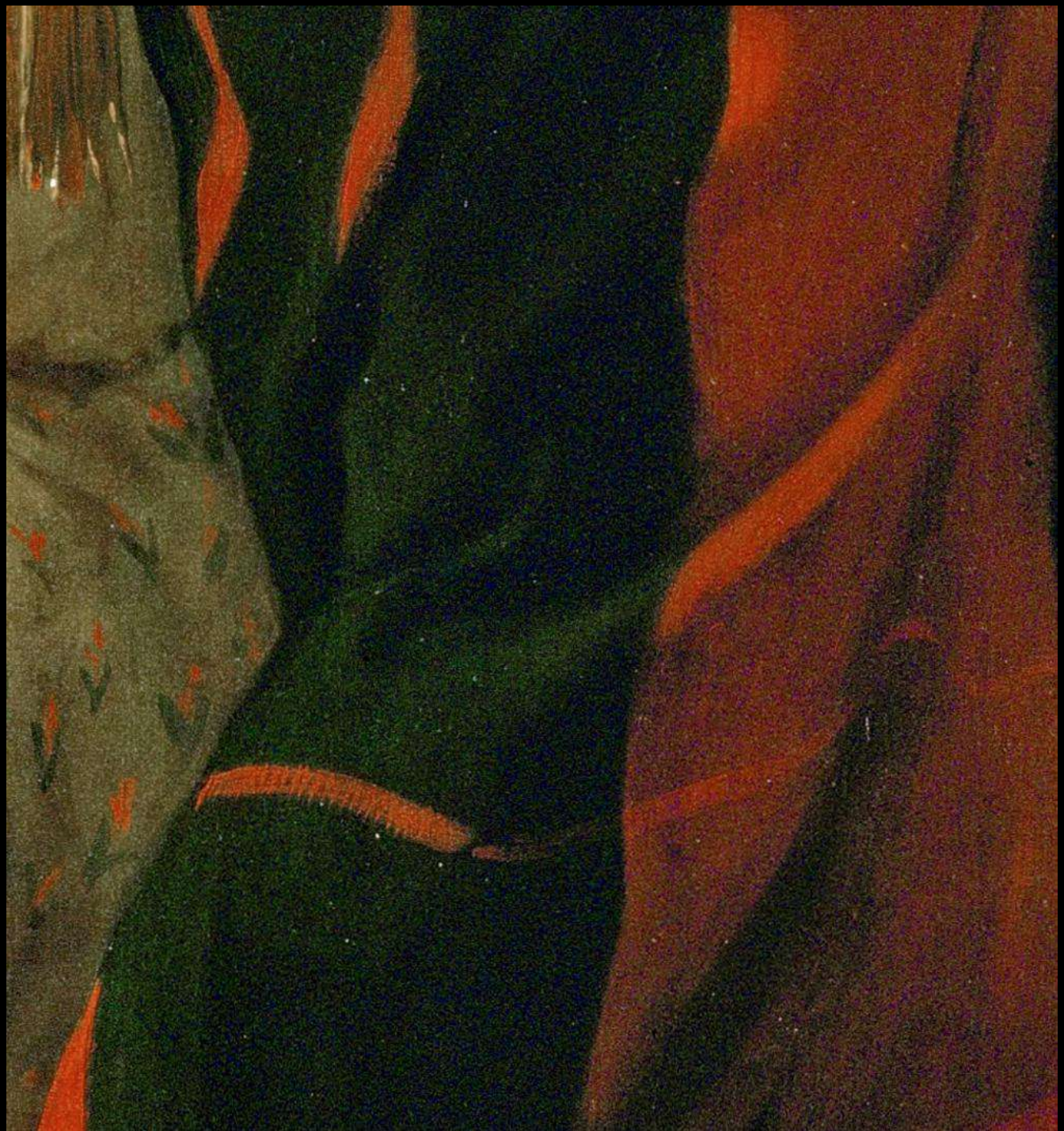
Research on Colour Theory & Nomenclature (names) by scientists for aesthetic ‘products’

- Michel Eugène Chevreul-- Chemist working in Gobelins carpet factory
- Noticed optical mixing of two adjacent colours
- *De la loi du contrast simultané des couleurs* 1839
- Influential on artists



Complementary Colours in art & design

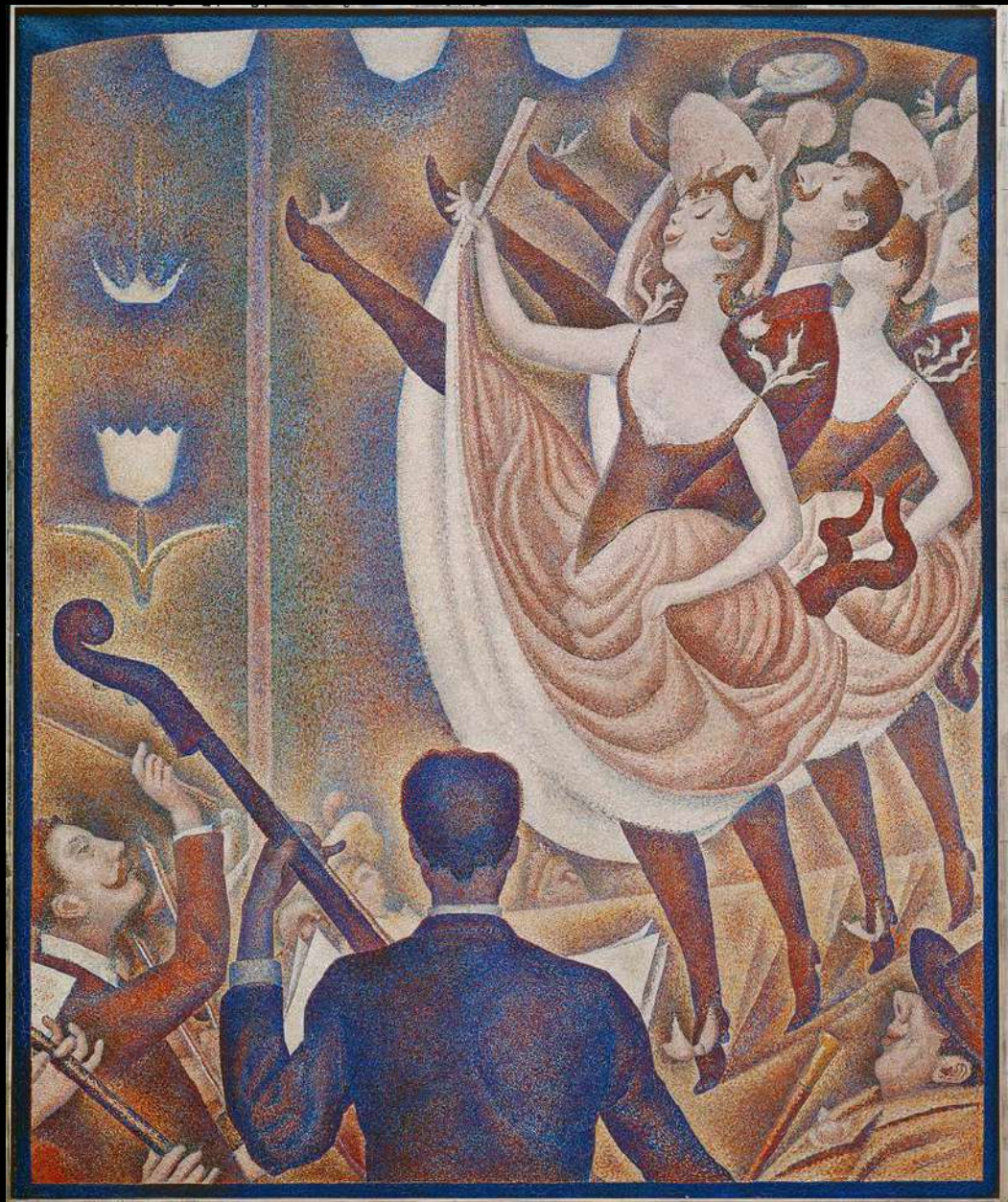
- 19th c. theories of “Simultaneous Contrast” and optical mixing Ex. Eugène Delacroix *Women of Algiers*



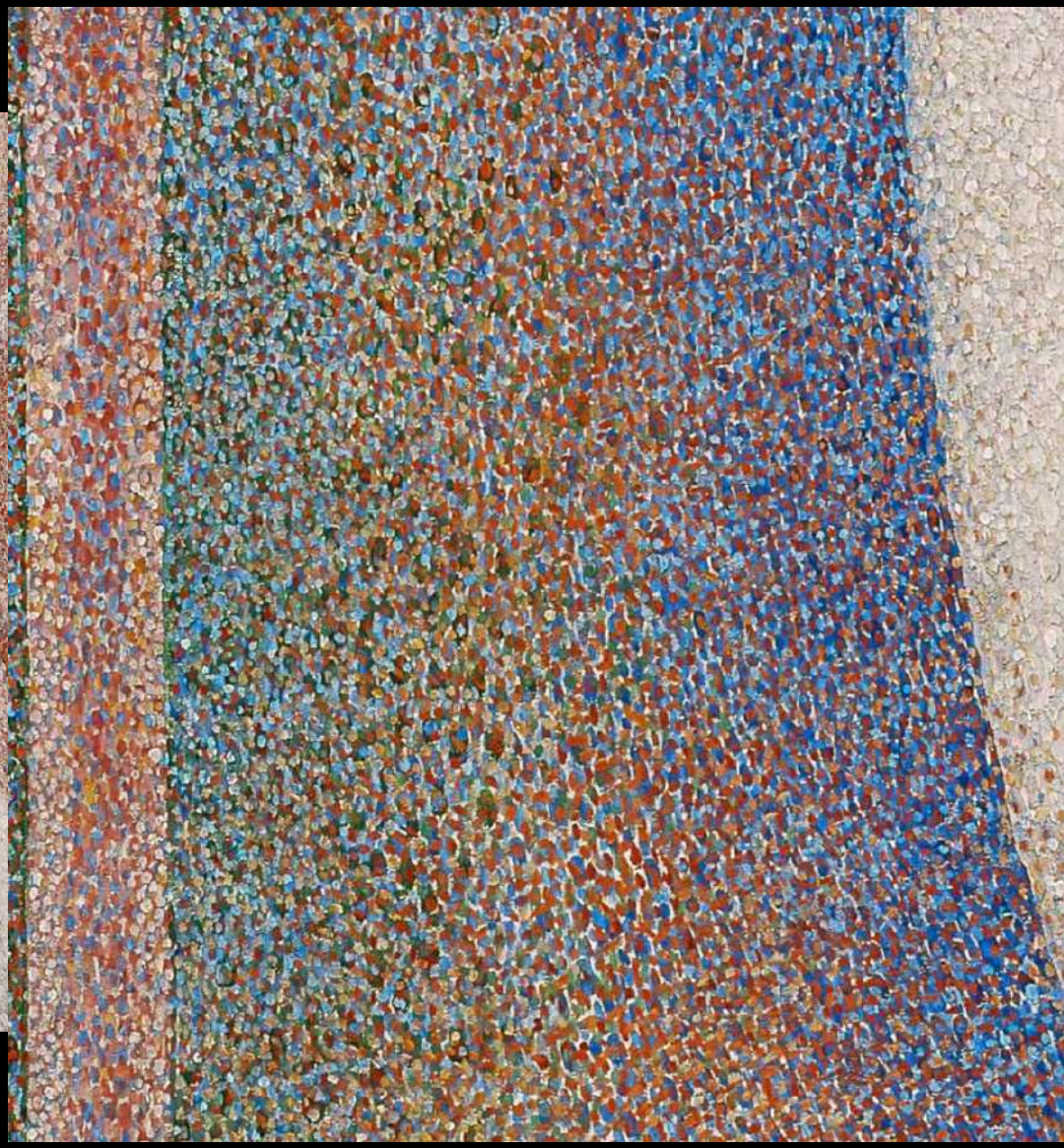
Detail

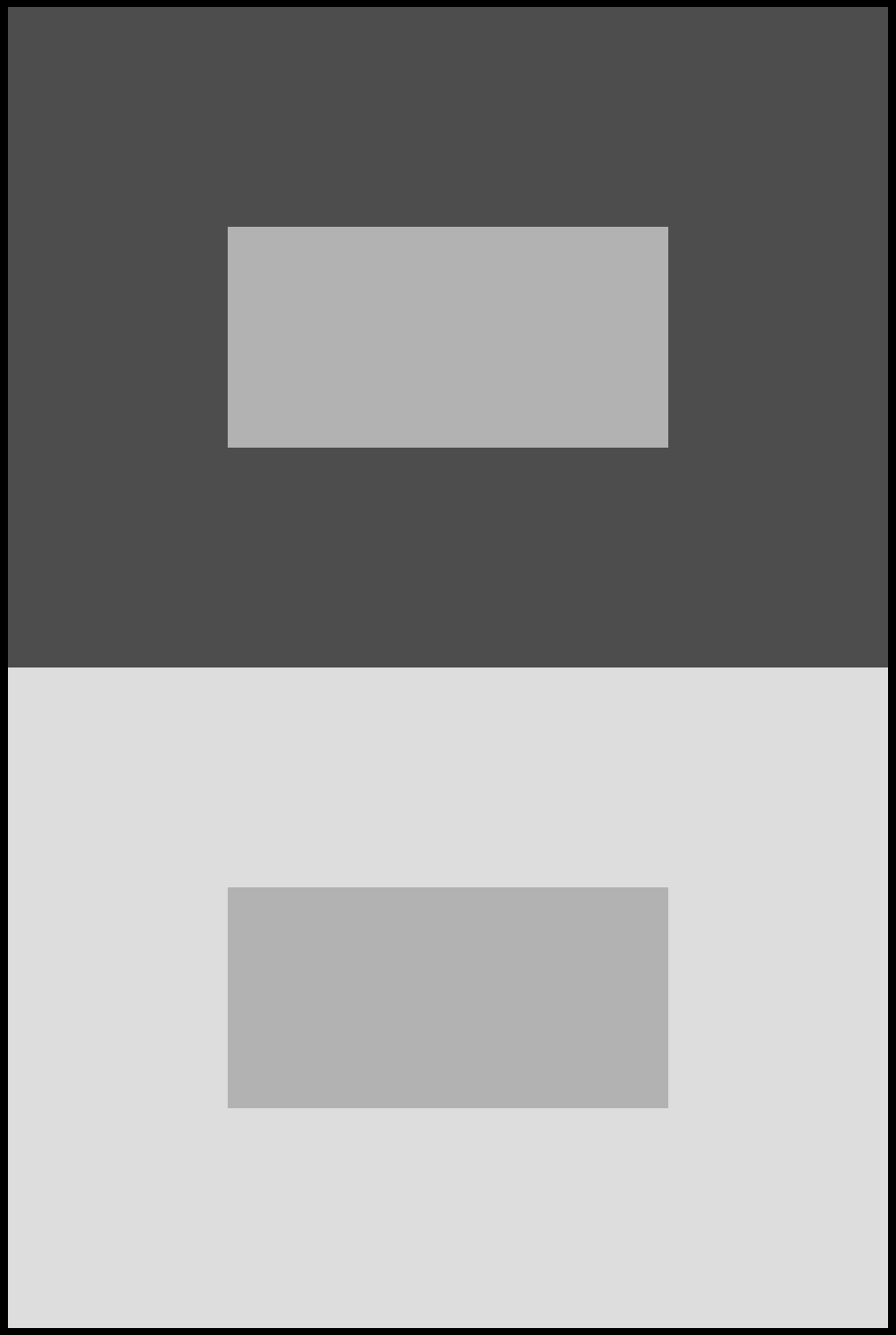
Complementary Colours in art & design

- optical mixing
  - Ex. Pointillism (neo-expressionism)--Seurat



Seurat *(details)*





optical effects of adjacent tonal values or colours

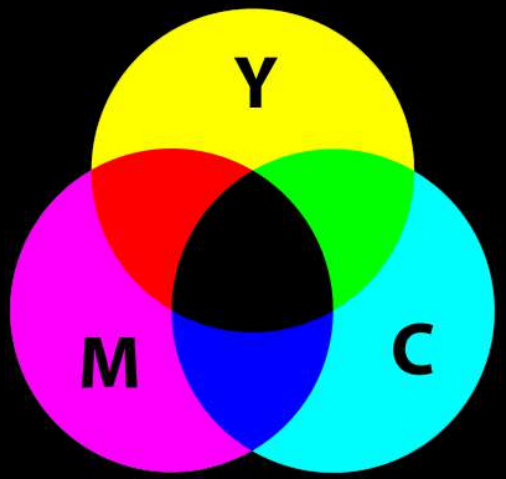
link to stroboscopic effects (complementary colors seen as grey)
http://www.michaelbach.de/ot/mot_strob/index.html

Colour Theory & Practical Applications in Design

- Video Clip from *The Devil Wears Prada*

Part of Pantone color swatch set with samples of color trends for designers (fall 2008)
www.pantone.com

Types of Colour Theories

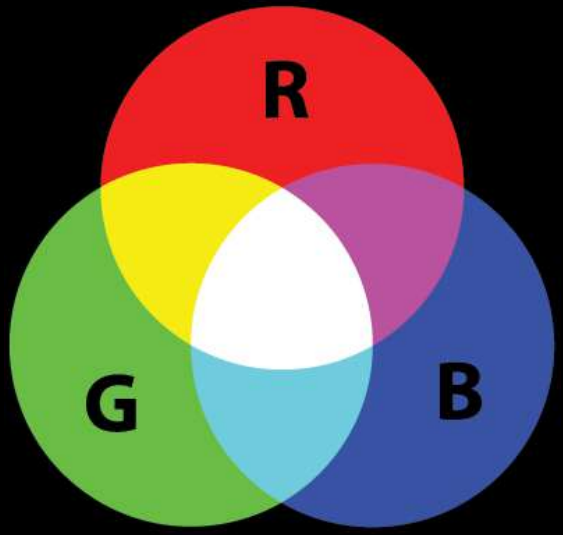


1. Subtractive Theory

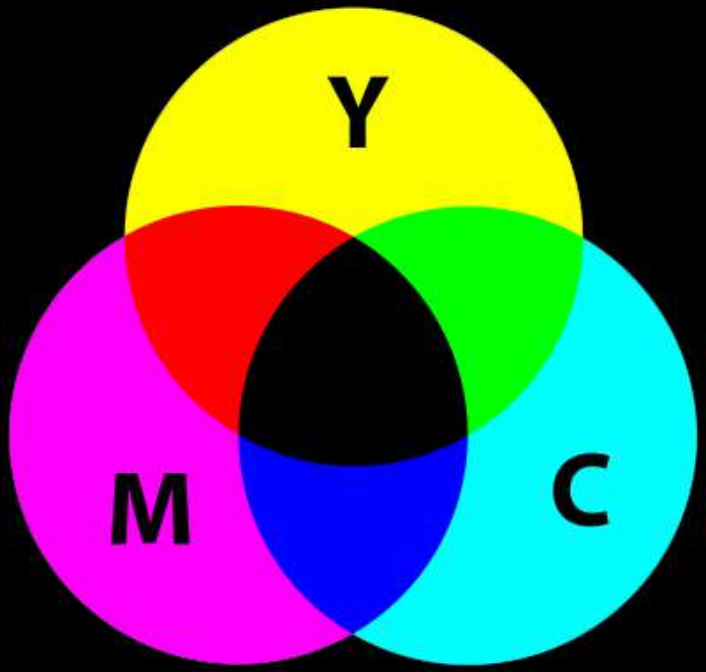
- The **subtractive**, or **pigment** theory deals with how white light is absorbed and reflected off of coloured surfaces.

2. Additive Theory

- The **Additive**, or **light** theory deals with radiated and filtered light.

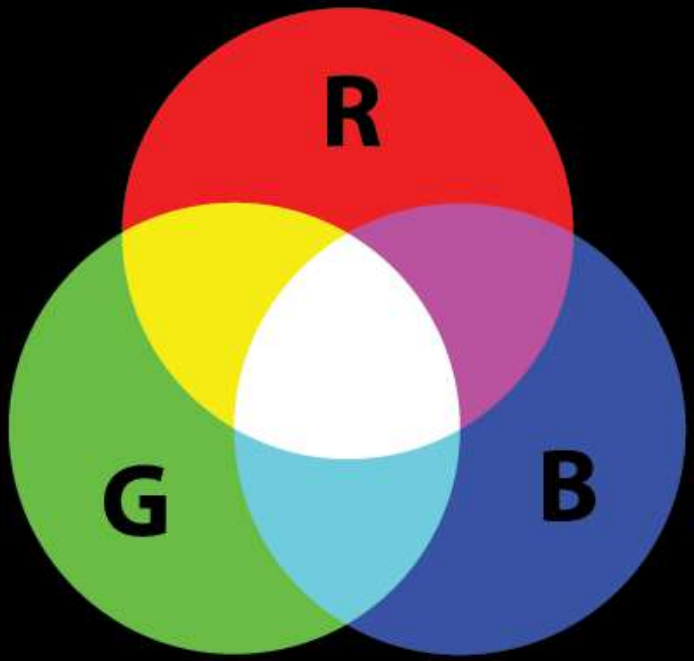


Subtractive Theory



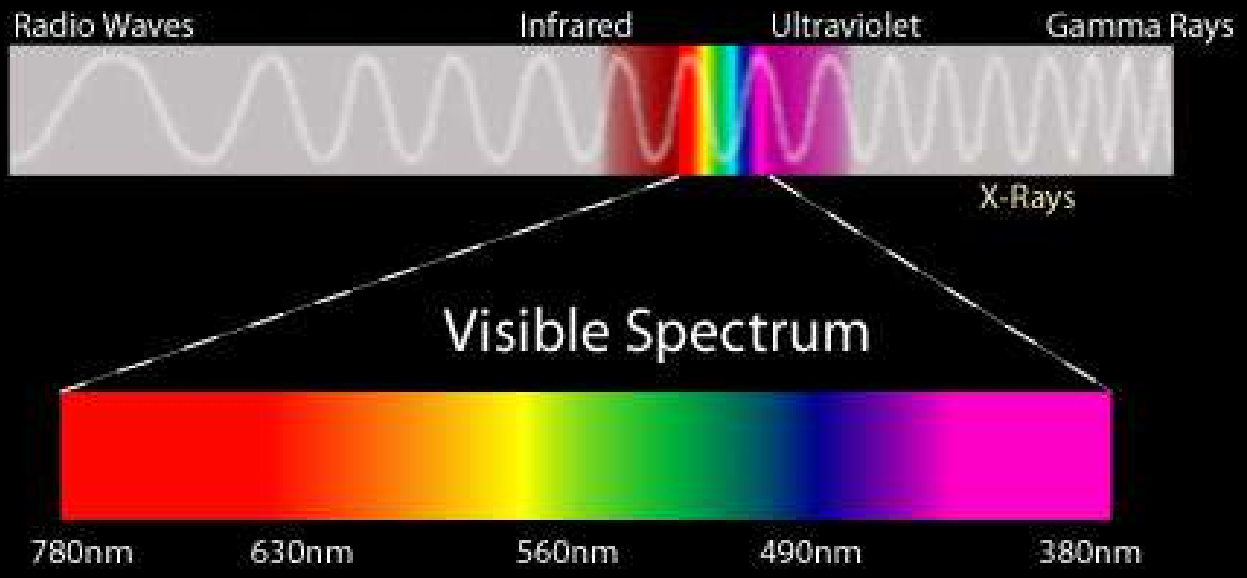
- Black absorbs most light
- White reflects most light
- Coloured Pigments absorb light and reflect only the frequency of the pigment colour.
- All colours other than the pigment colours are absorbed so this is called subtractive colour theory.
- The primary colours in Subtractive Theory are:
  - Cyan(C)
  - Magenta(M)
  - Yellow(Y)
  - Black(K)
- Subtractive or Pigment Theory is used in printing and painting.

Additive Theory

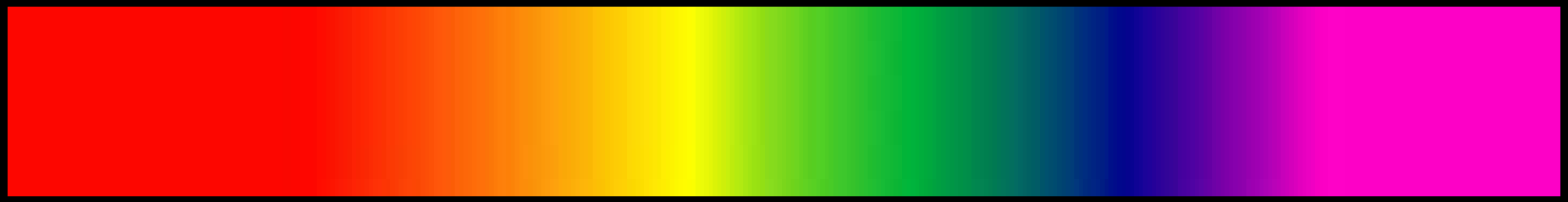


- Black radiates no light
- White (sun) radiates all light
- Video is the process of capturing and radiating light, therefore it uses Additive (Light) Theory not Subtractive (Pigment) Theory.
- The primary colours in Additive Theory are:
  - Red(R)
  - Green (G)
  - Blue(B)
- The primary colours add together to make white
- Light Theory is also called Additive Theory.
- Light Theory is used in Television, theater lighting, computer monitors, and video production.

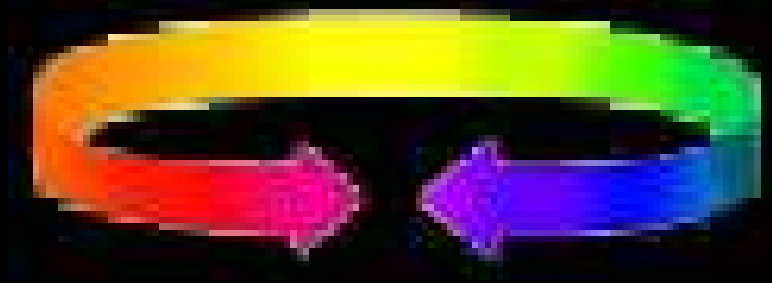
The Visible Spectrum



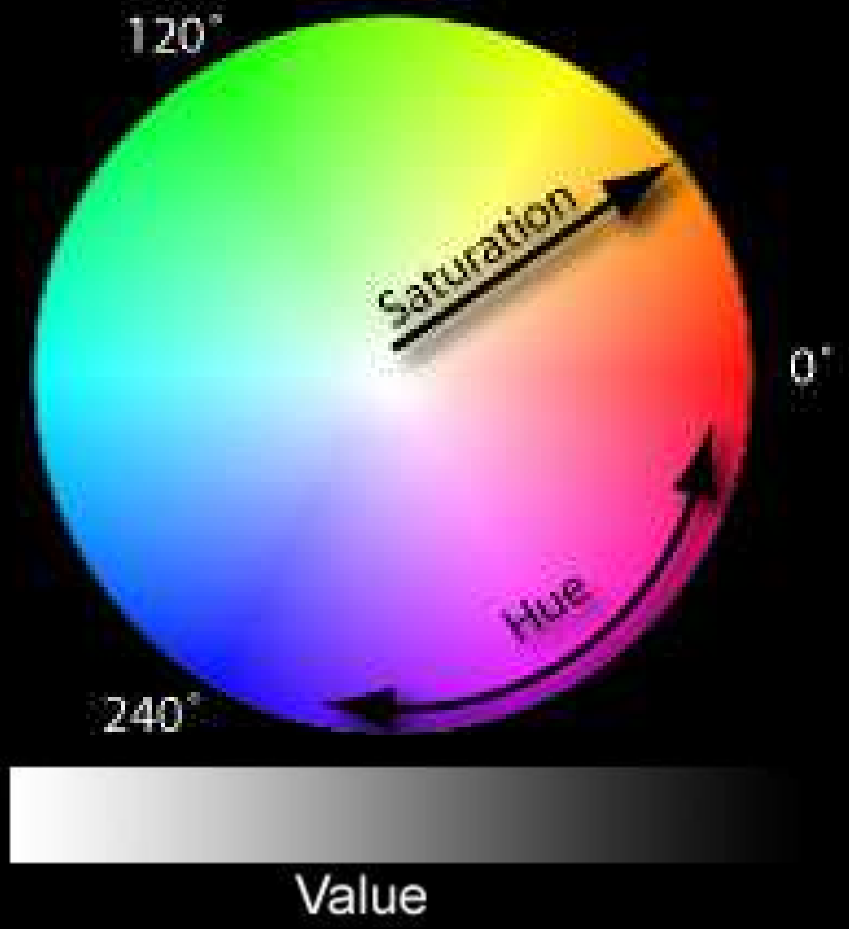
The Colour Wheel



If the ends of the spectrum are bent around a colour wheel is formed:



The Colour Wheel



- **Colours on the wheel can be described using three parameters:**

1. **Hue**: degrees from 0˚ to 360˚
2. **Saturation**: brightness or dullness
3. **Value**: lightness or darkness

(As suggested by Henry Albert Munsell in *A Colour Notation,* 1905)

The Colour Wheel: Hue

- Hue or Spectral Colour is represented as an angle.
- **Primary Colours:**
  - 0˚ = Red
  - 120˚= Green
  - 240˚= Blue
- **Secondary Colours:**
  - 60˚= Yellow
  - 180˚= Cyan
  - 300˚= Magenta

The Colour Wheel: Saturation

- Saturation or Chroma is the intensity of a colour.
- A highly saturated colour is bright and appears closer to the edge of the wheel.
- A more unsaturated colour is dull.
- A colour with no saturation is achromatic or in the grey scale.

The Colour Wheel: Value

"the quality by which we distinguish a light colour from a dark one."

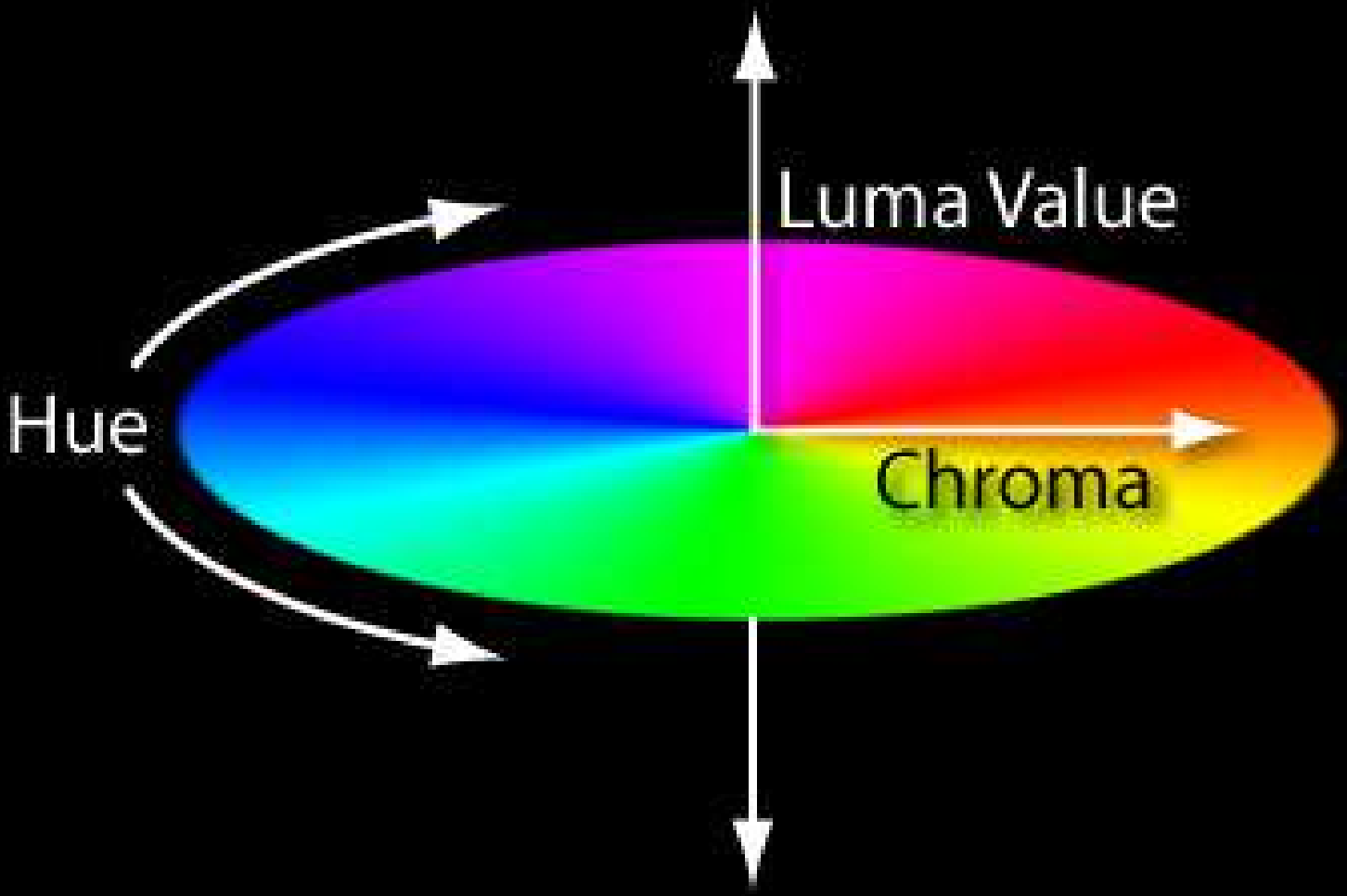
- Albert Henry Munsell

A Colour Notation 1905

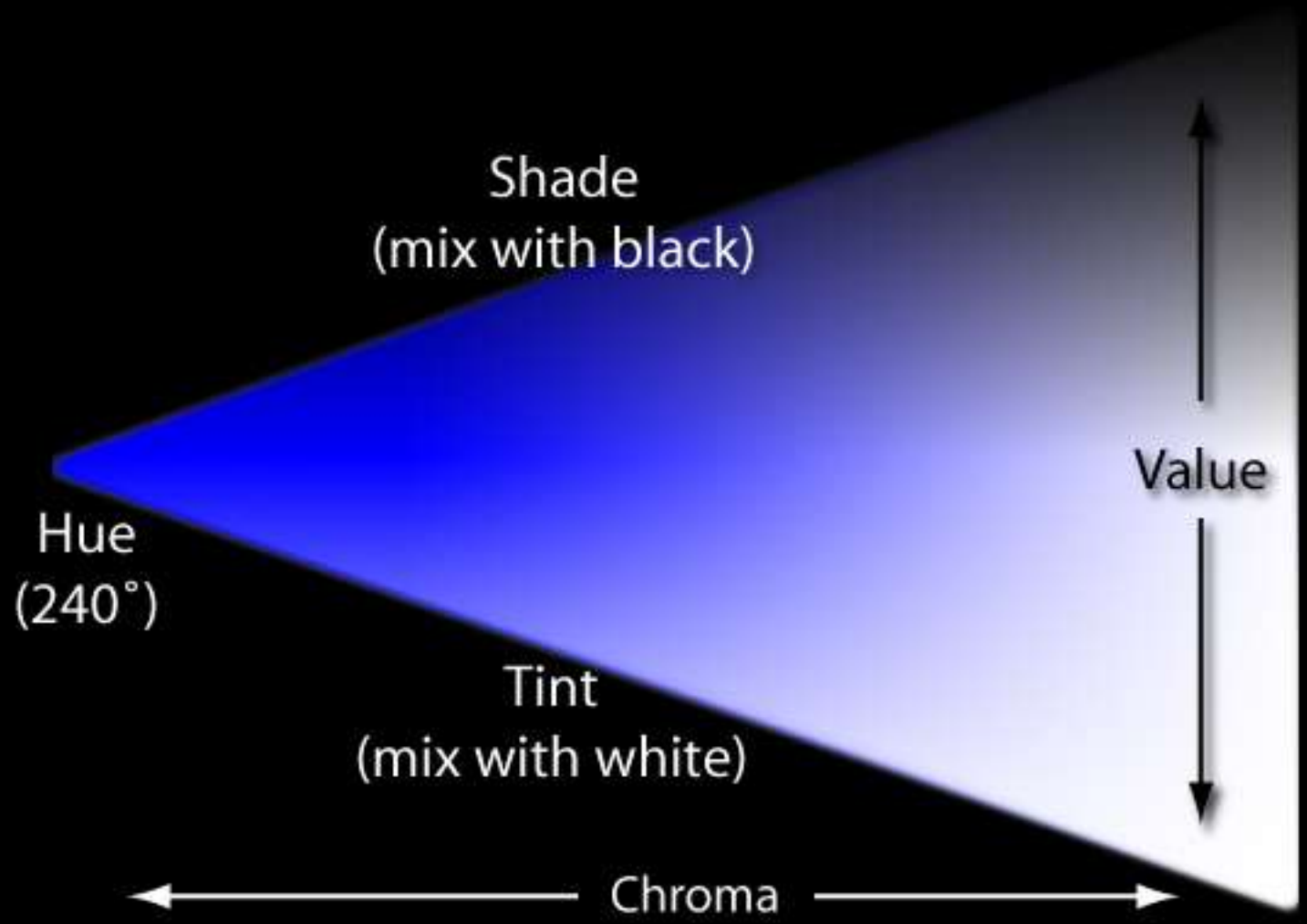
Value represents the luminescent contrast value between black and white

The Colour Wheel 3d

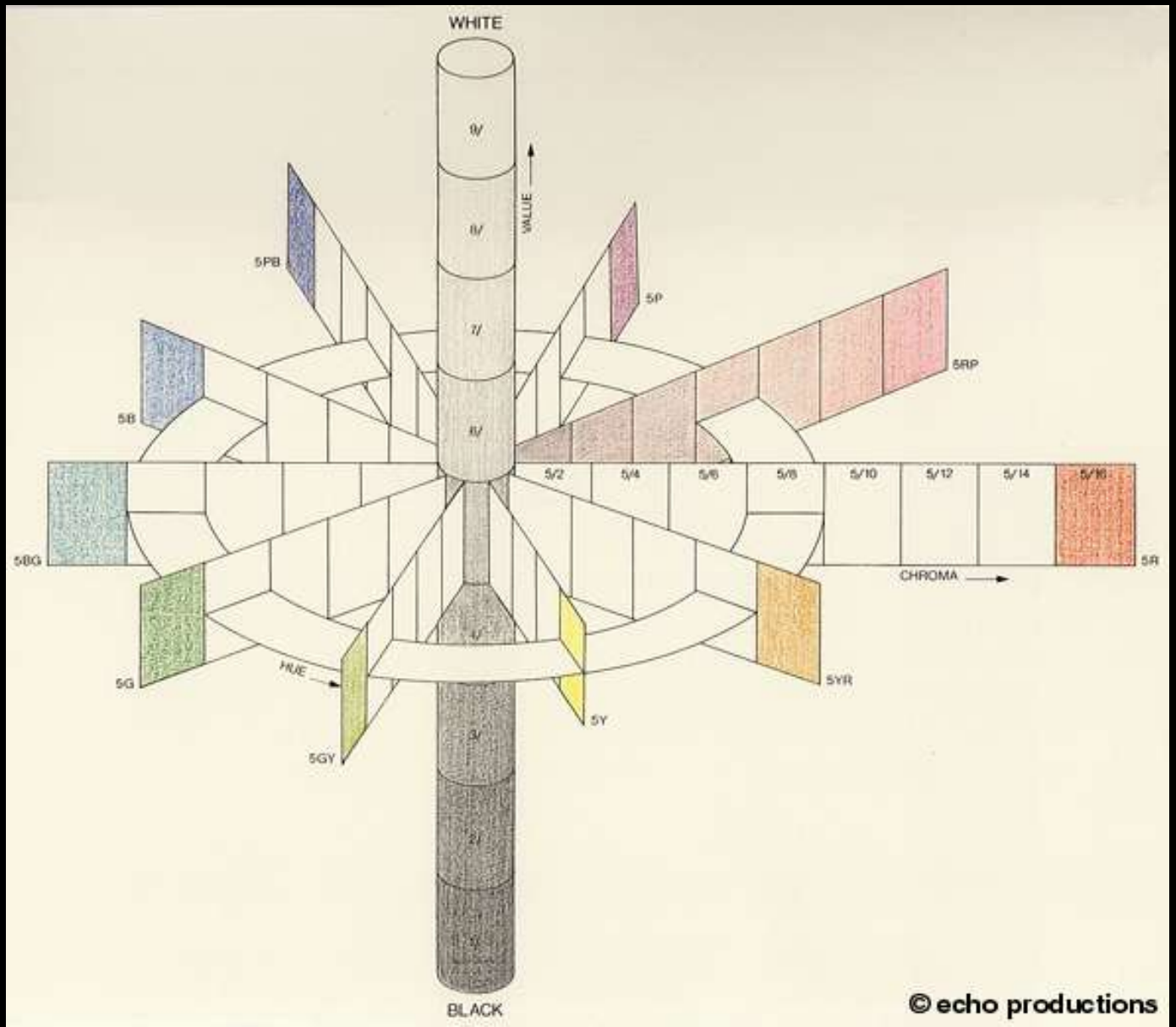
Three parameters to describe a colour: Hue
Chroma Value



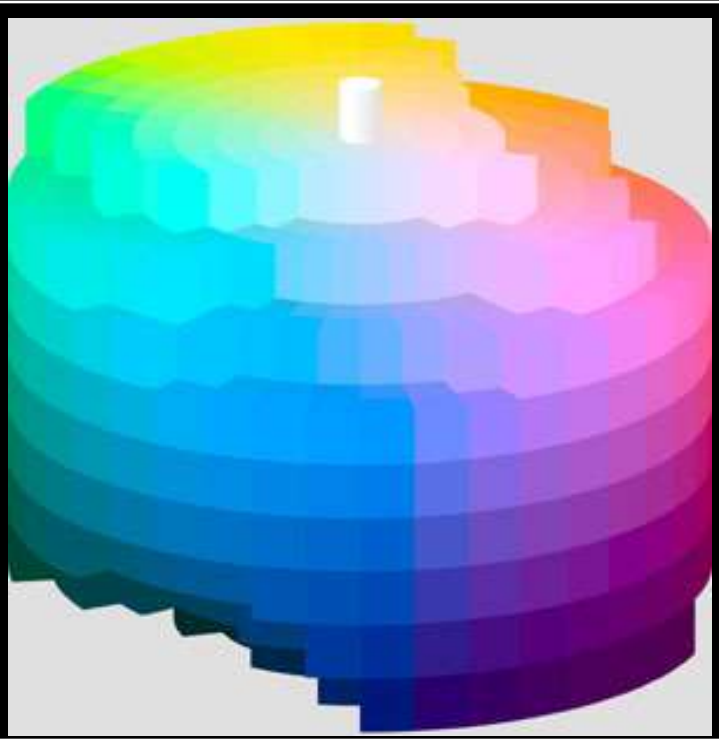
Tone = Shade + Tint



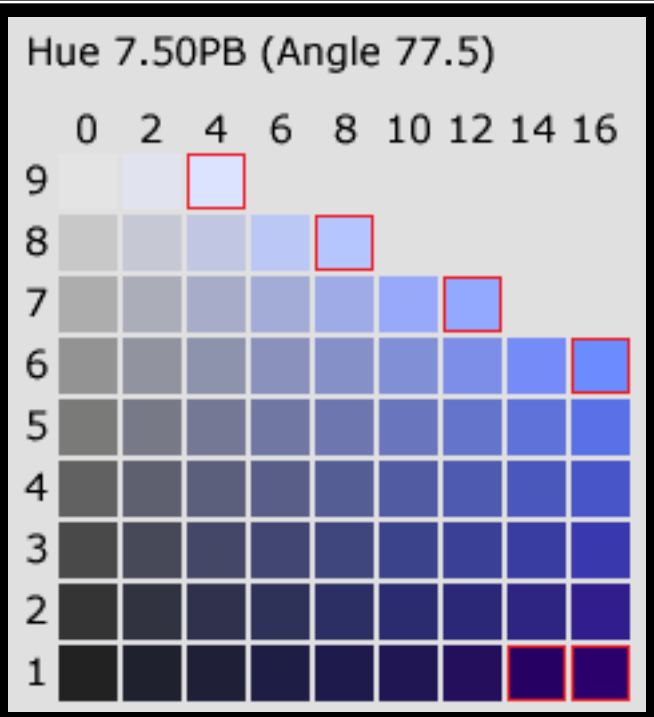
MANY more scientific models based on different colour theory: (Example: Colour Tree by American artist Henry Albert Munsell from *A Colour Notation,* 1905.)



More Illustrations of the Munsell System



3D representation of the Munsell color model. The vertical axis represents value (or brightness) and ranges from 0 (black) to 10 (white). Distance from the center represents chroma (or saturation). Values start at 0 (gray) and go to anywhere from 4 to 30, depending on how saturated the color can get. The angle around the middle represents the hue (or color).

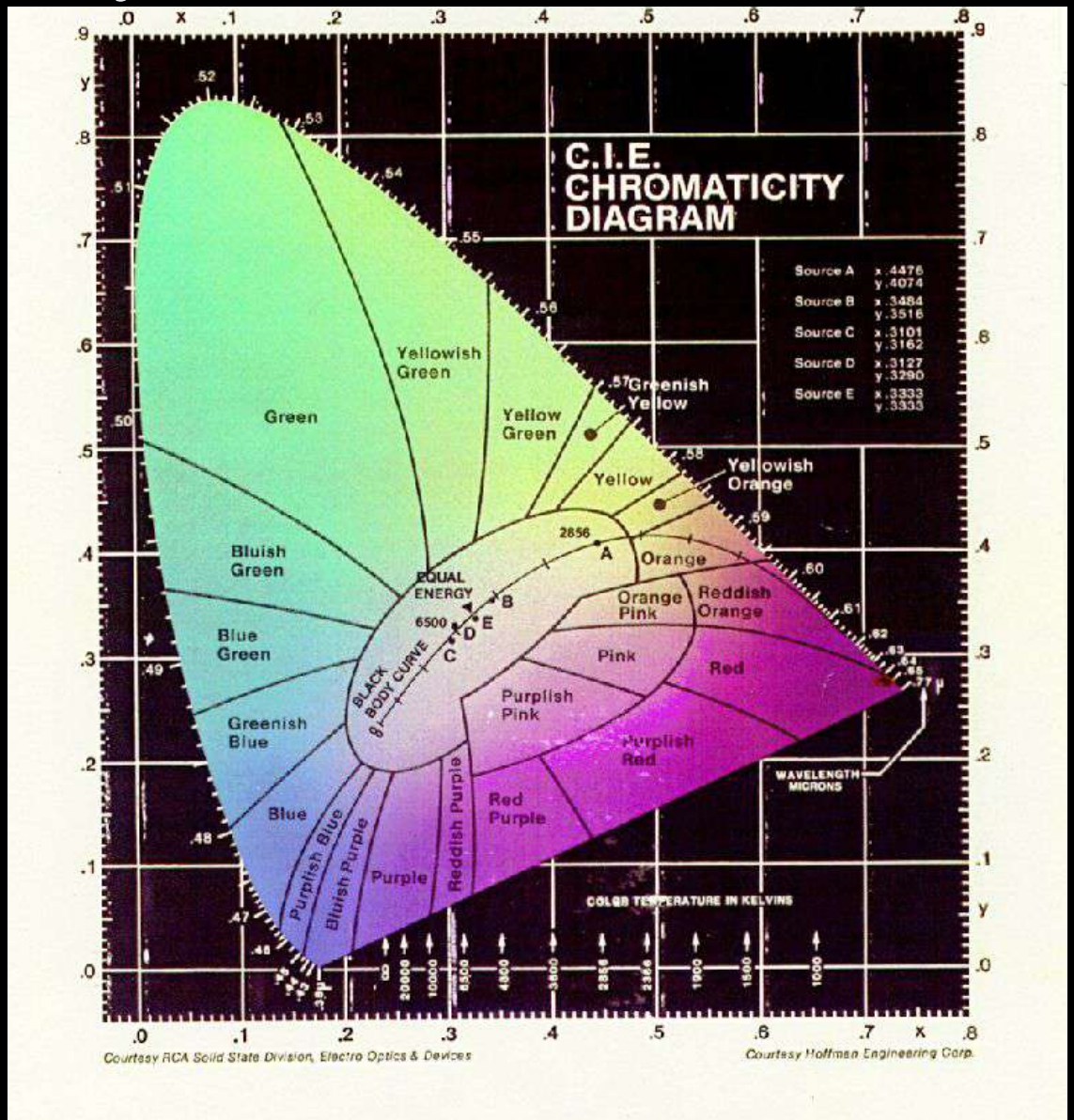


One wedge of the Munsell color model. Chroma increases horizontally, and value vertically. Colors with a red border indicate paint colors that cannot accurately be reproduced on an rgb monitor (approximated colors are shown). These diagrams only extend to a chroma value of 16 despite some colors extending well beyond this limit.

Source: http://ian-albert.com/graphics/munsell.php

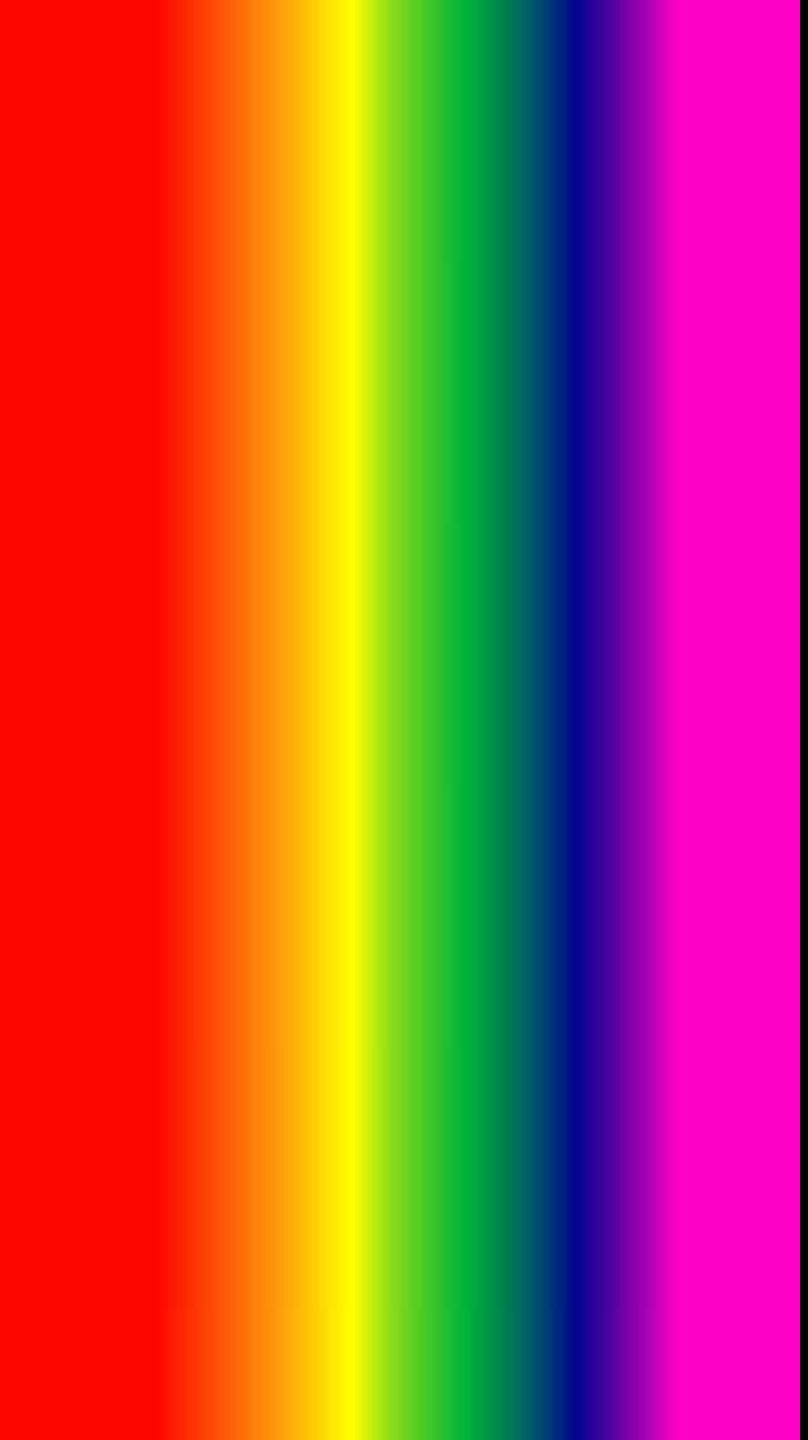
Scientific & Industry-specific Color systems

- CIE (Commission internationale d'éclairage),
- and MANY others



Using Color--

- blue in large regions, not thin lines
- red and green in the center of the field of view (edges of retina not sensitive to these)
- black, white, yellow in periphery
- Color Brewer
- Pantone



Colour Schemes

Systematic ways of selecting colours

- Monochromatic
- Complimentary
- Analogous
- Warm
- Cool
- Achromatic
- Chromatic Grays

Colour Schemes: Monochromatic

Artist: Marc Chagall
Title: Les Amants Sur Le Toit

- **Monochromatic:**

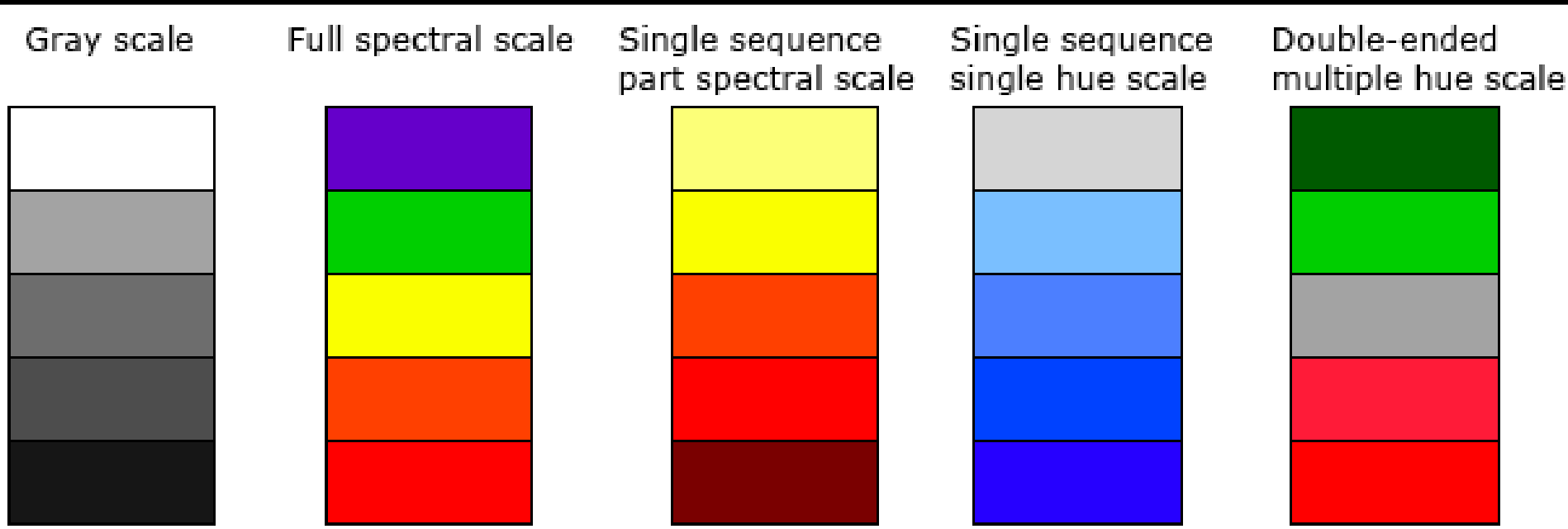
One Hue many values of Tint and Shade

Colour Schemes: Complementary (note spelling--NOT complimentary)

Artist: Paul Cezanne
Title: La Montage Saint Victoire
Year: 1886-88

- **Complimentary:** Colours that are opposite on the wheel. High Contrast

Color for Categories and Sequences



Colour Schemes: Analogous

Artist: Vincent van Gogh
Title: The Iris
Year: 1889

- **Analogous**: A selection of colours that are adjacent. Minimal contrast

Colour Schemes: Warm

Artist: Jan Vermeer
Title: *Girl Asleep at a Table*
Year: 1657

Warm: First half of the wheel give warmer colours. The colours of fire.

Colour Schemes: Cool

Artist: Pablo Picasso
Title: Femme Allongée Lisant
Year: 1939

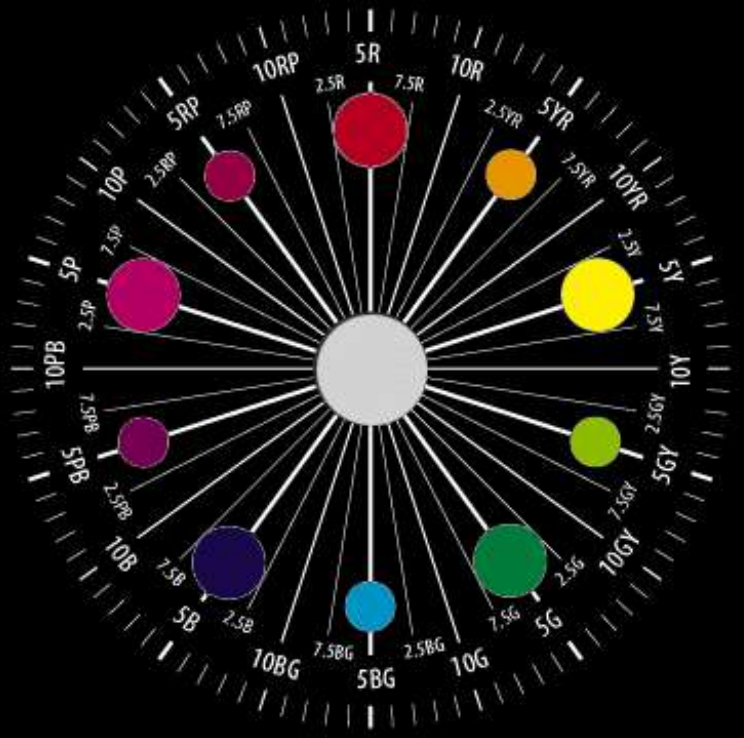
Cool: Second half of the wheel gives cooler colours

Colour Schemes:
Achromatic, Chromatic Grays

Achromatic: Black and white with all the grays in-between.

Chromatic Grays: Also called neutral relief. Dull colours, low contrast.

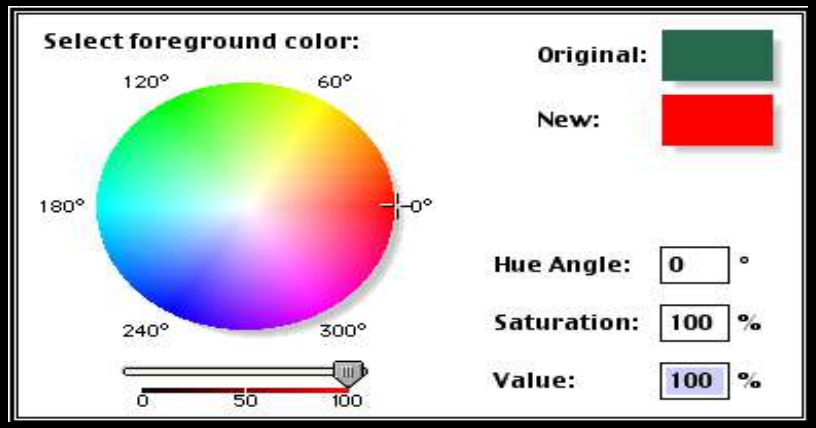
Colour Pickers & Choice of Media

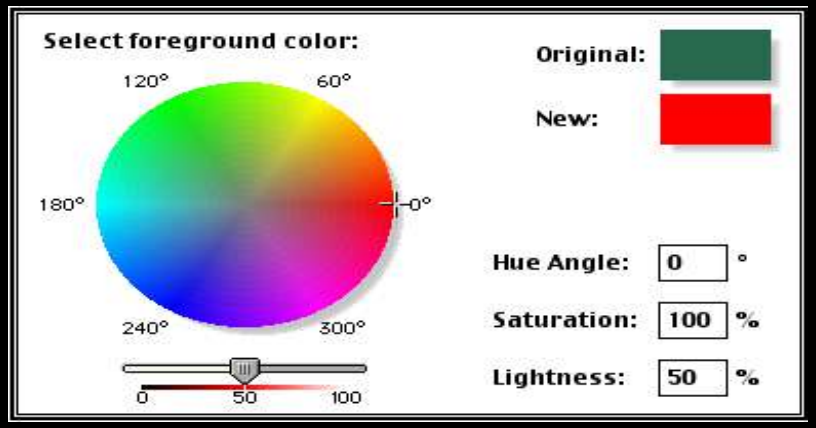


Munsell's notation wheel

- HSB, HLS, HSV
- RGB
- CMYK
- Others
  - Lab
  - PANTONE

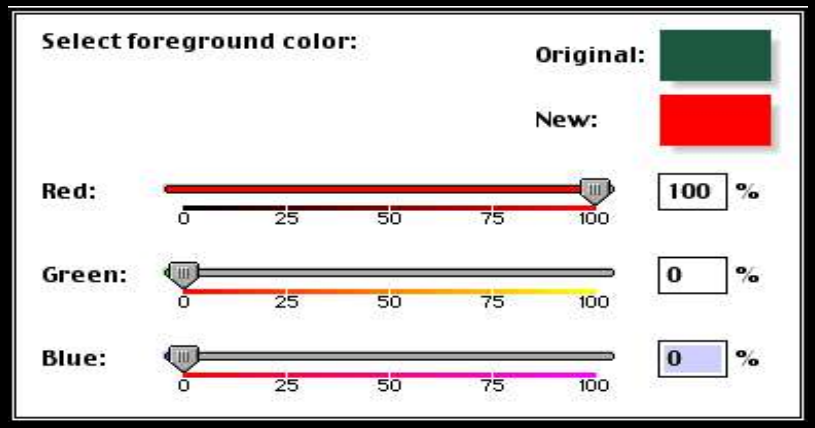
Colour Pickers: HSB, HLS, HSV

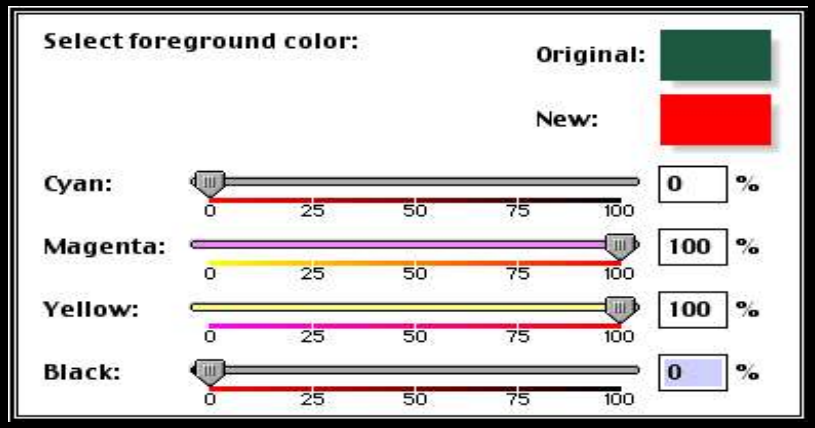




- HSV
  - Hue
  - Saturation
  - Value
- HSB (Same as HSV)
  - Hue
  - Saturation
  - Brightness
- HLS
  - Hue
  - Lightness
  - Saturation

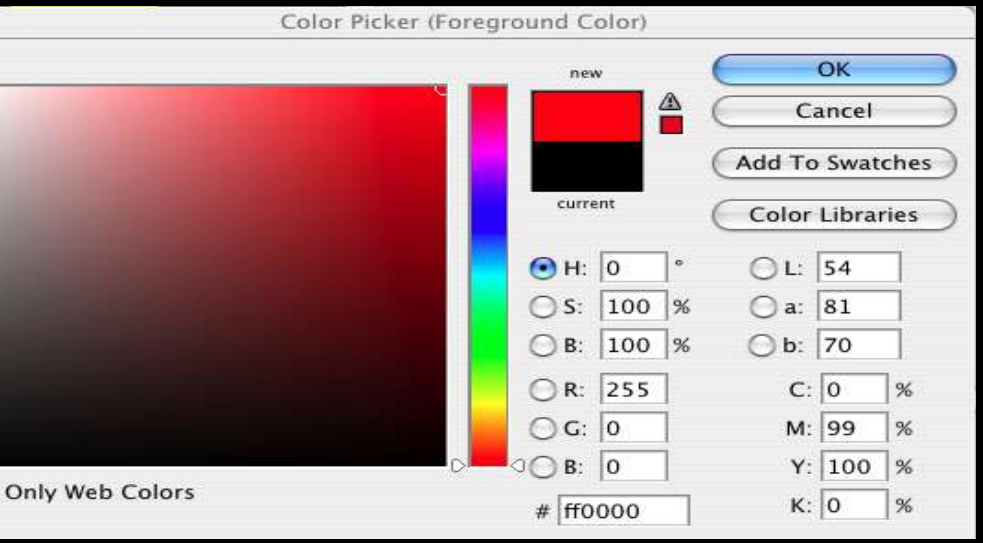
Colour Pickers: RGB, CMYK





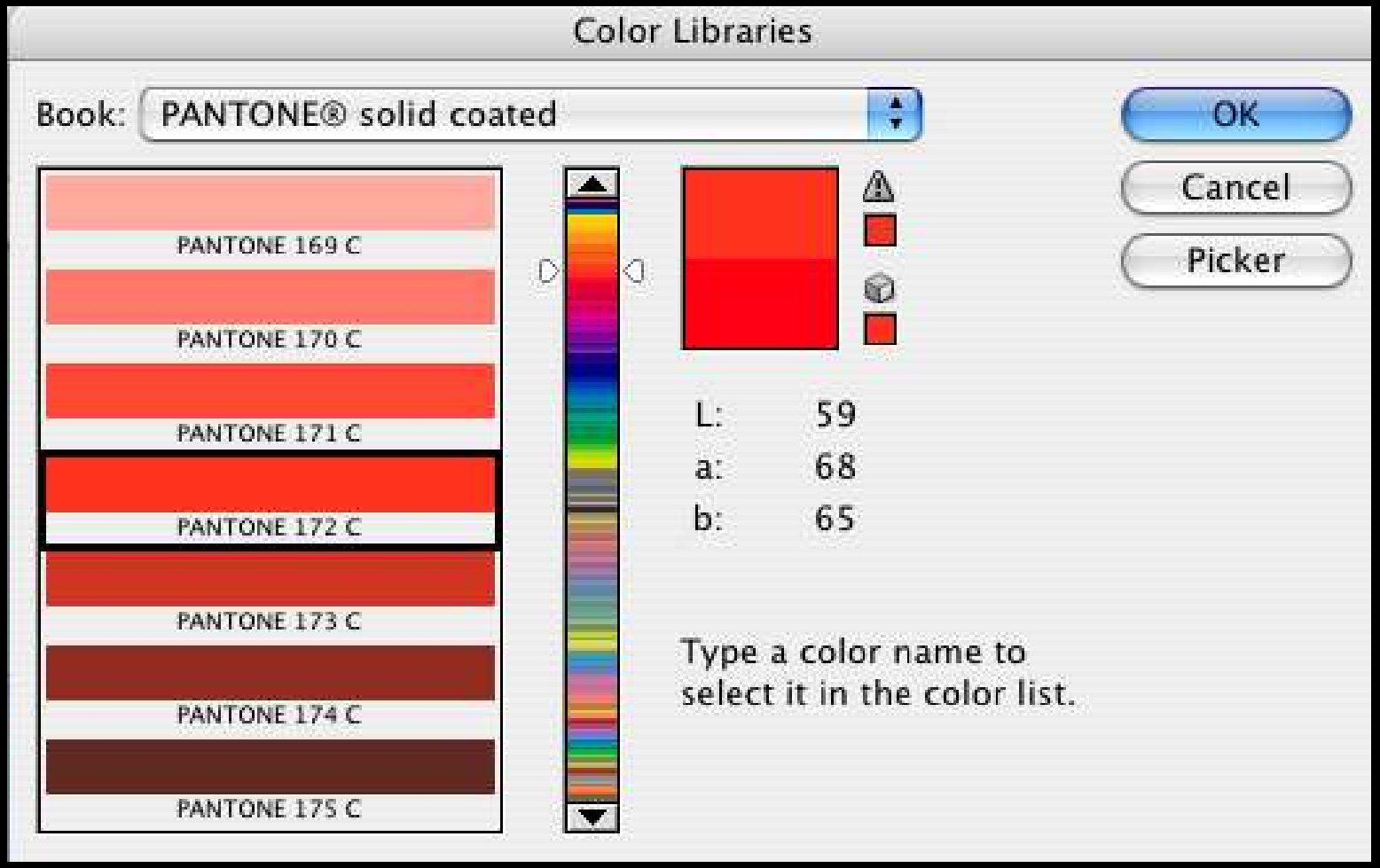
- RGB
  - Red
  - Green
  - Blue
  - Used in Video and Computer graphics
  - 3 Values in % or between
    - 0-255
- CMYK
  - Cyan
  - Magenta
  - Yellow
  - K = Black
  - Used for printing

Photoshop CS3 Picker



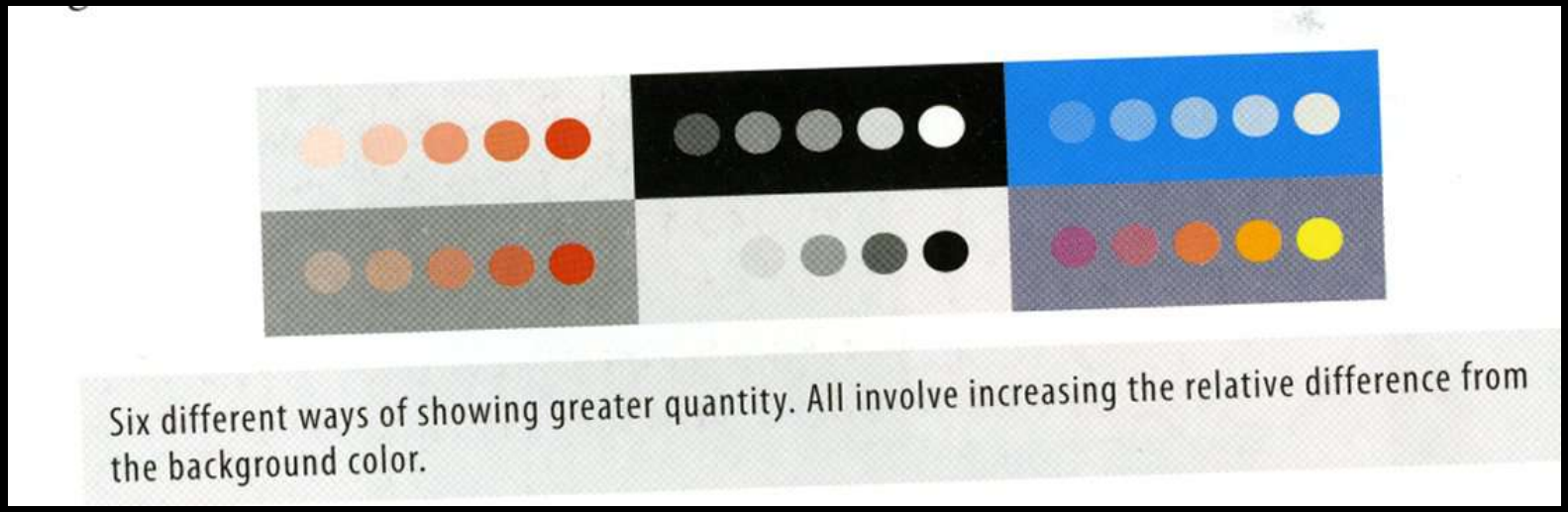
- Combines HSB, RGB, CMYK, Lab (Luminance, Red/Green, Yellow/Blue)
- Adobe
- http://kuler.adobe.com/

Colour Pickers: PANTONE



- Standard for printing/fastion industry

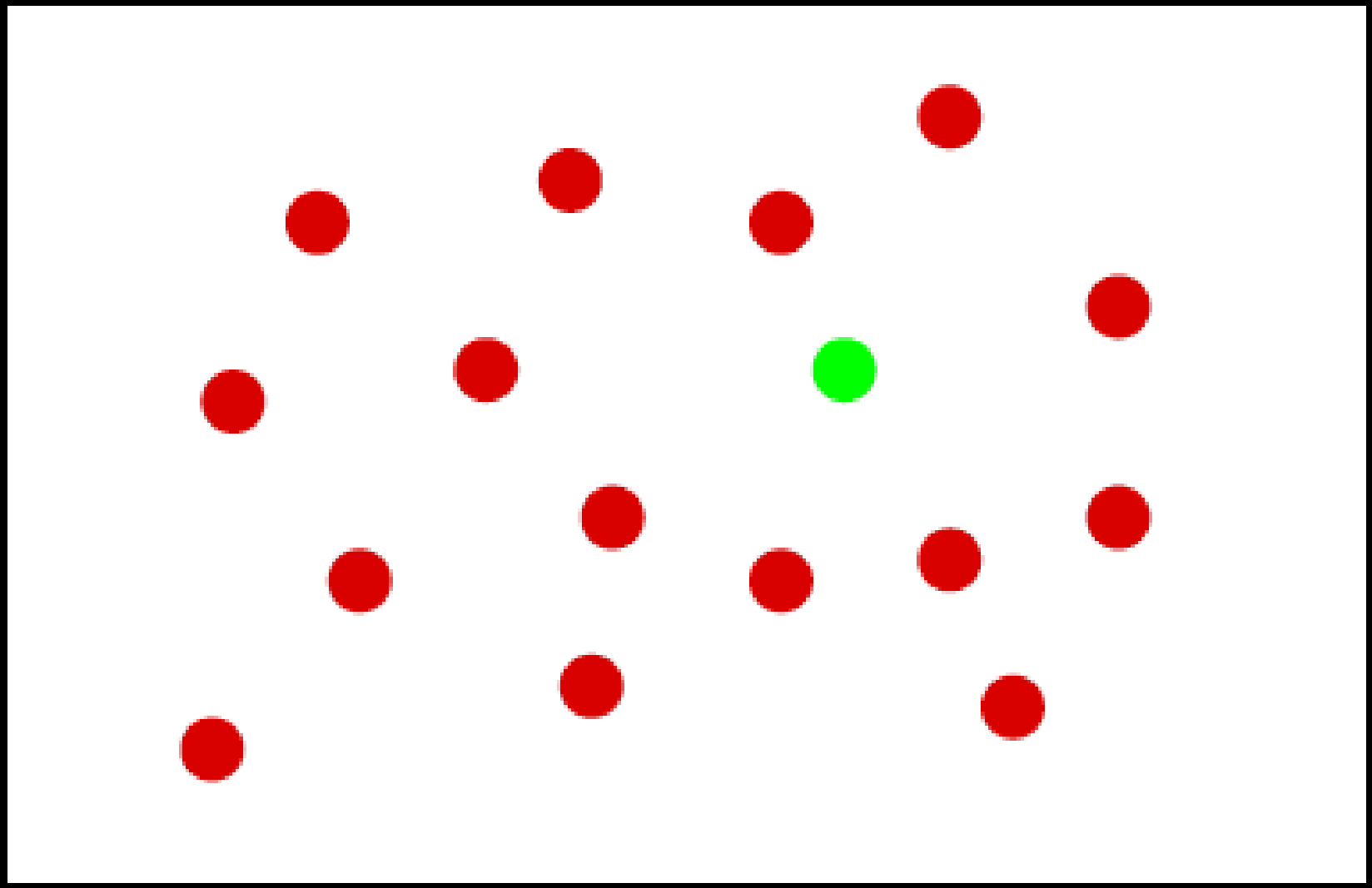
Color and the visual display of information



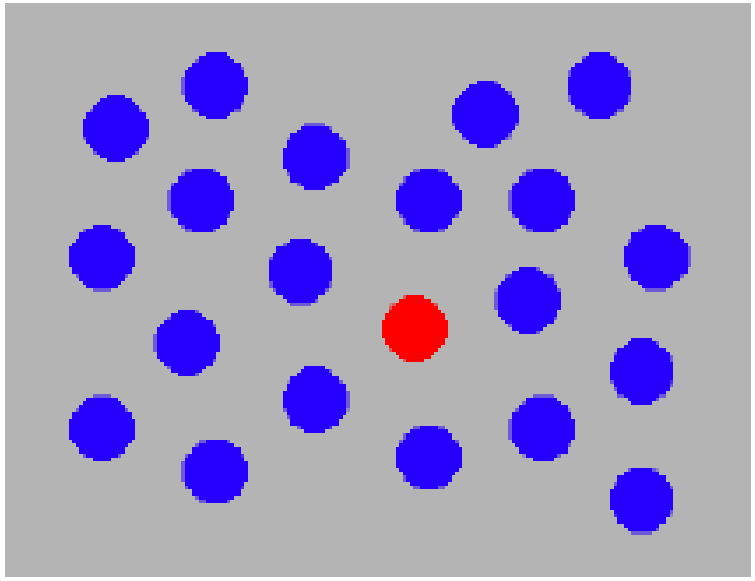
Six different ways of showing greater quantity. All involve increasing the relative difference from the background color.

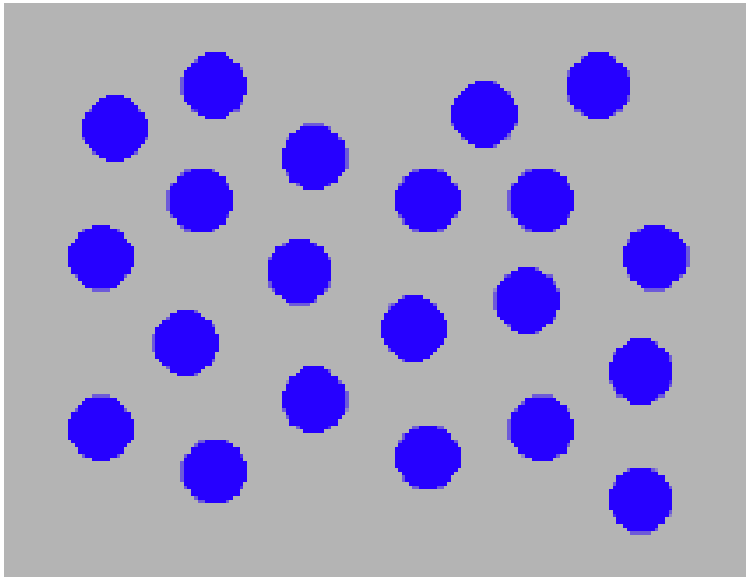
Ware, p. 84

Colour (hue) and counting or searching



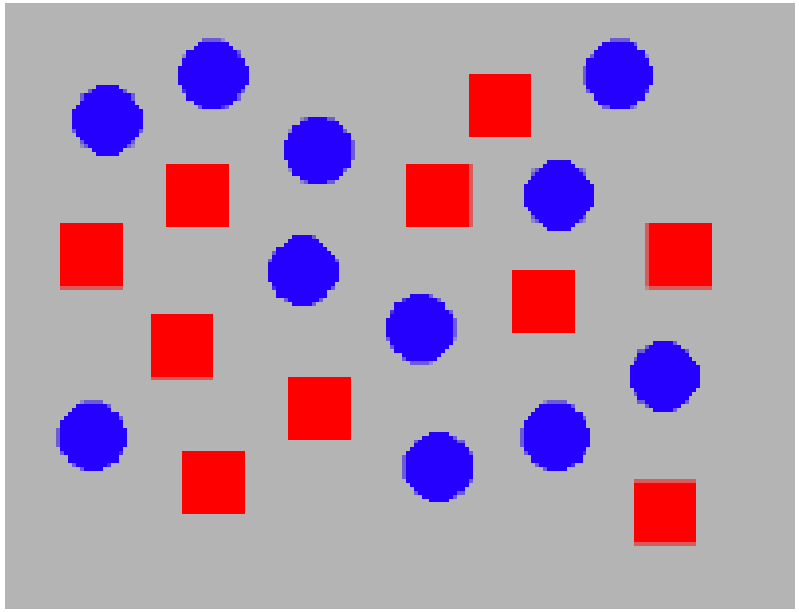
Hue

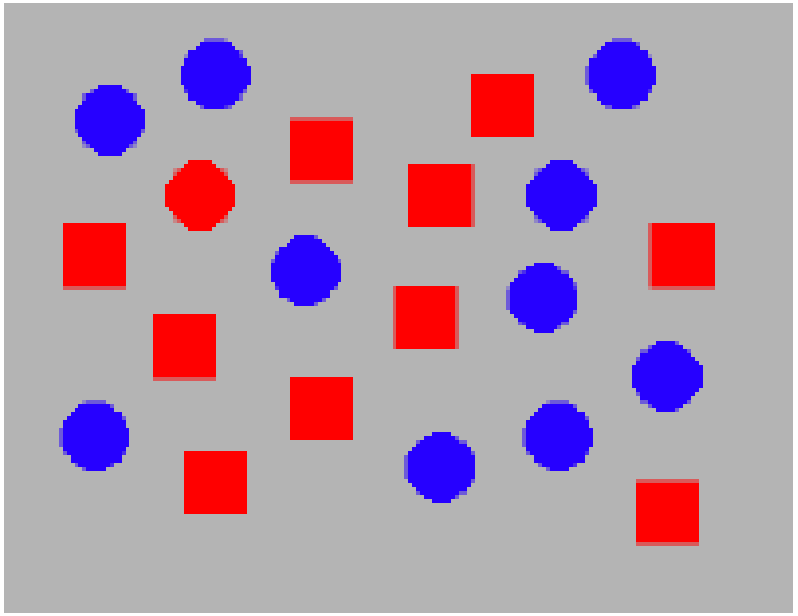




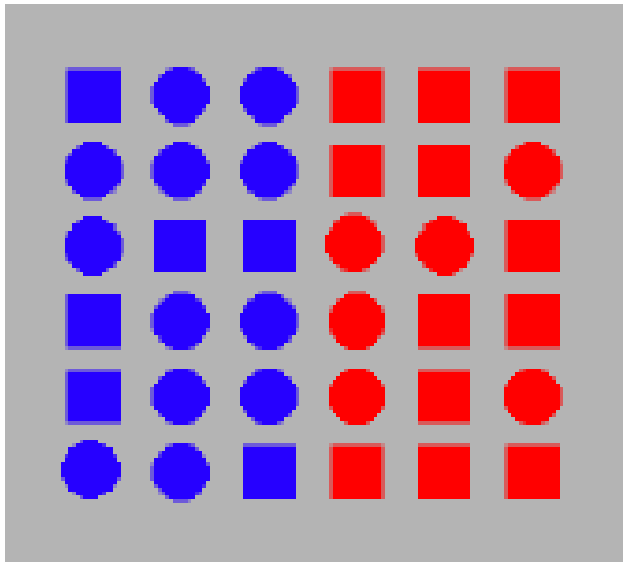
- Not Usually Pre-attentive

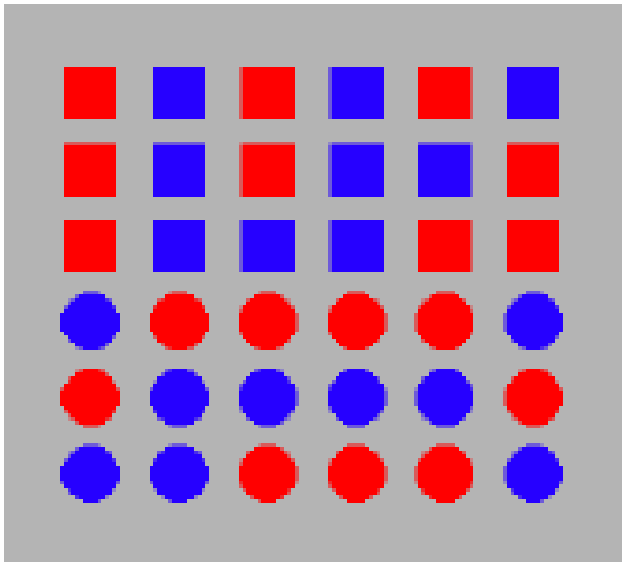
Hue & shape





Region Search





Hue boundary identified pre-attentively

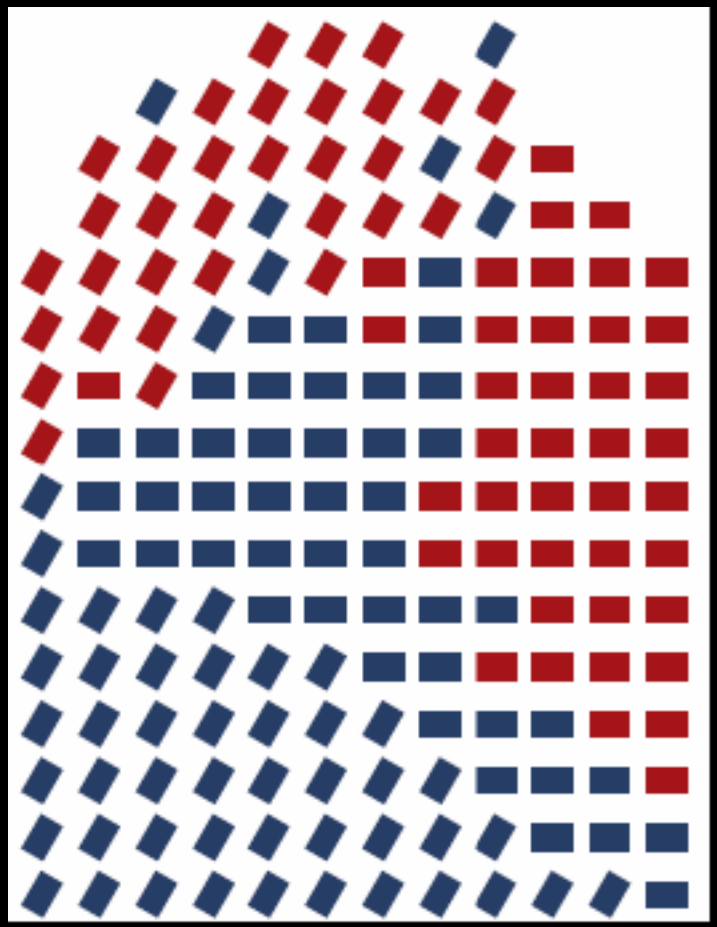
Form variations do NOT interfere with hue boundary identification

Form boundary NOT identified pre-attentively

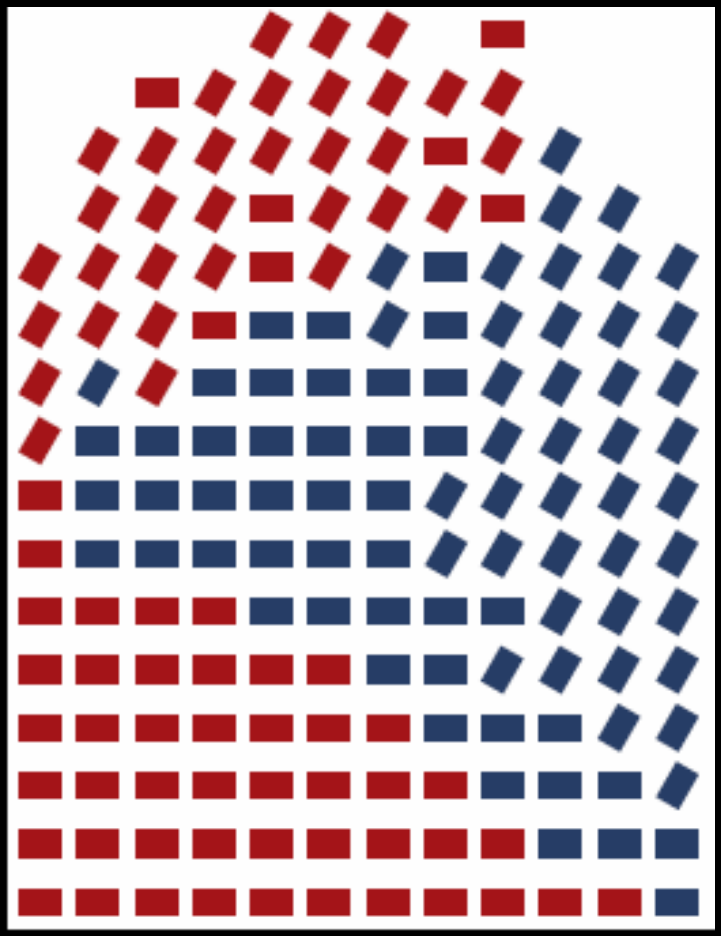
Hue variations interfere with form boundary identification

Area Estimation

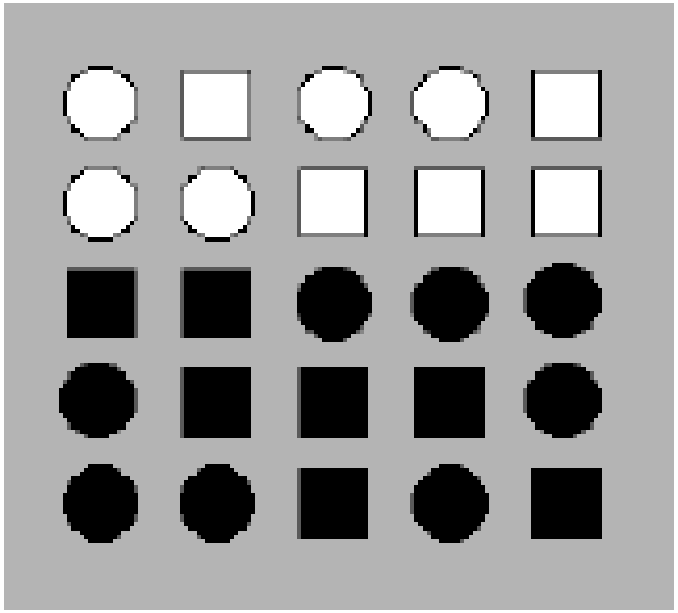
- Blue rectangles?

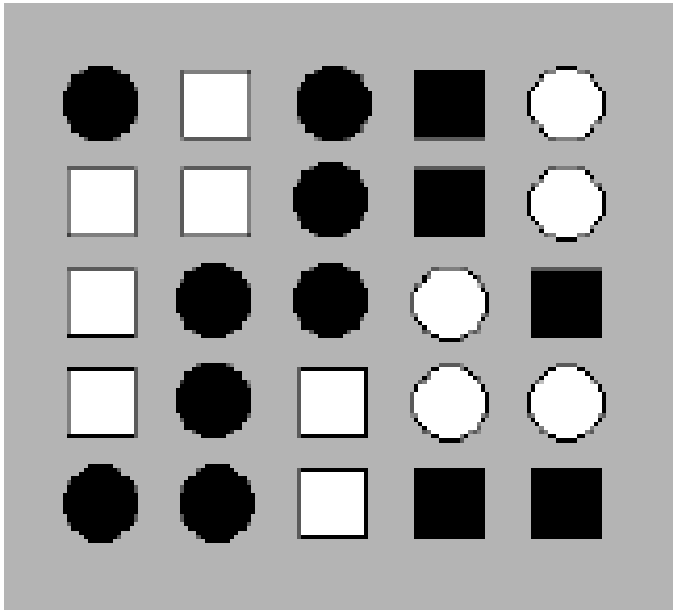


Sloped rectangles?

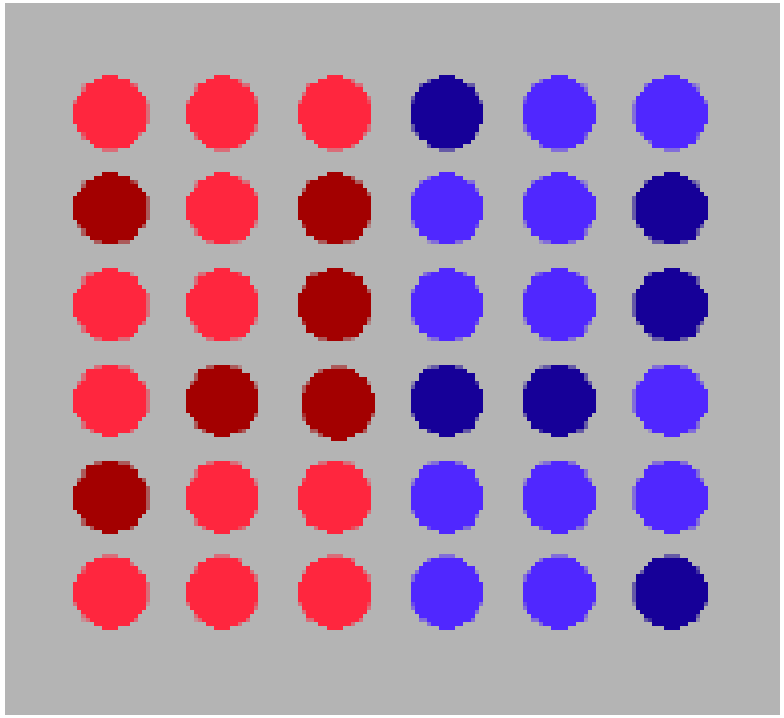


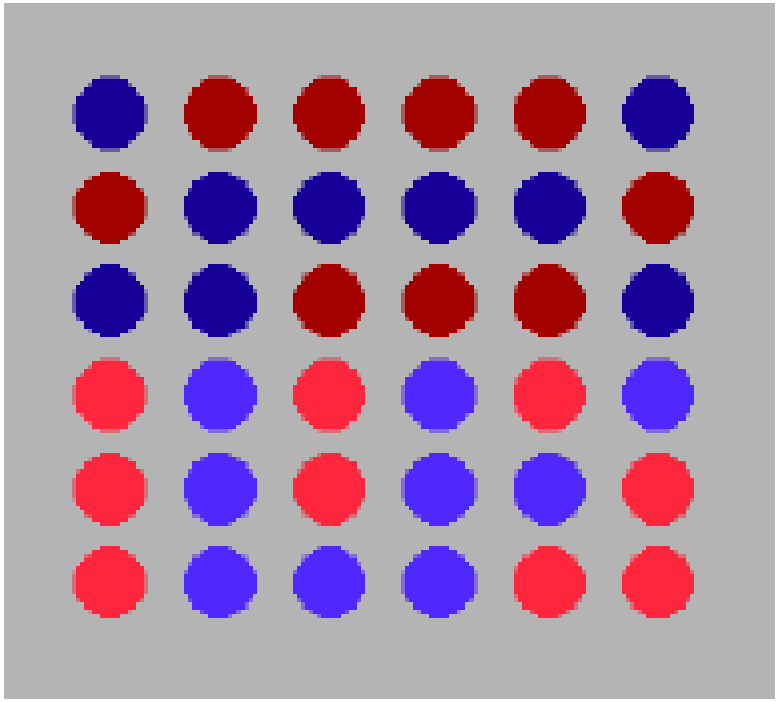
Fill and Shape



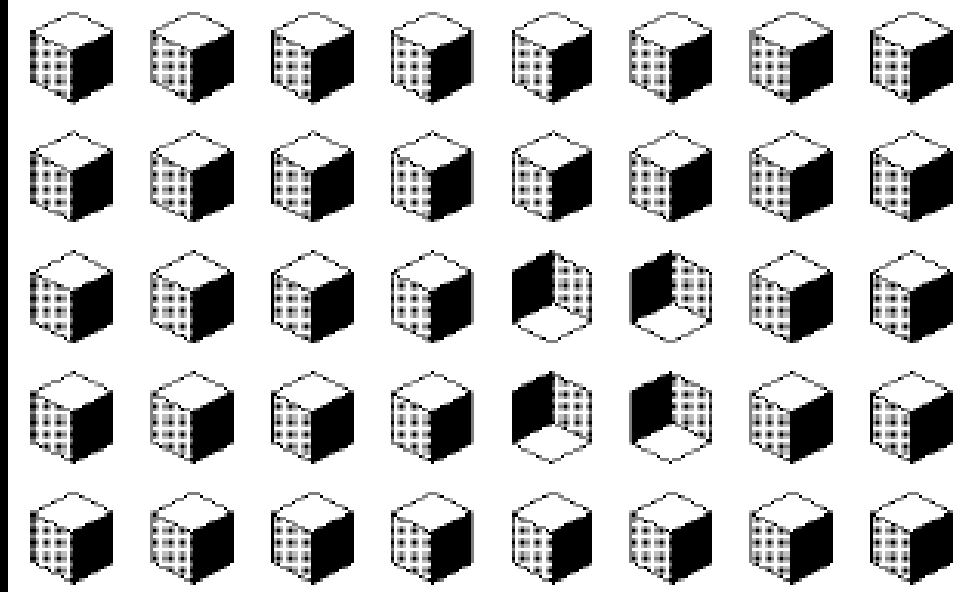


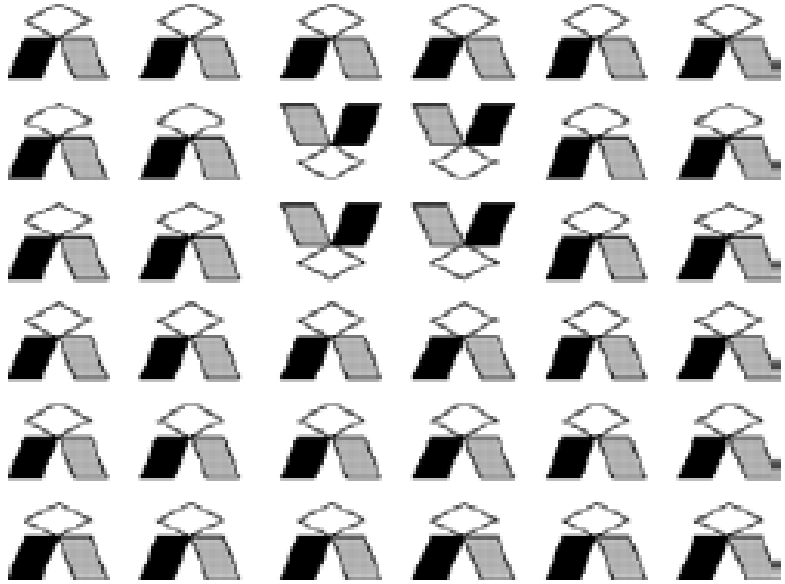
Brightnesss





Shape again





Luminance/Contrast