

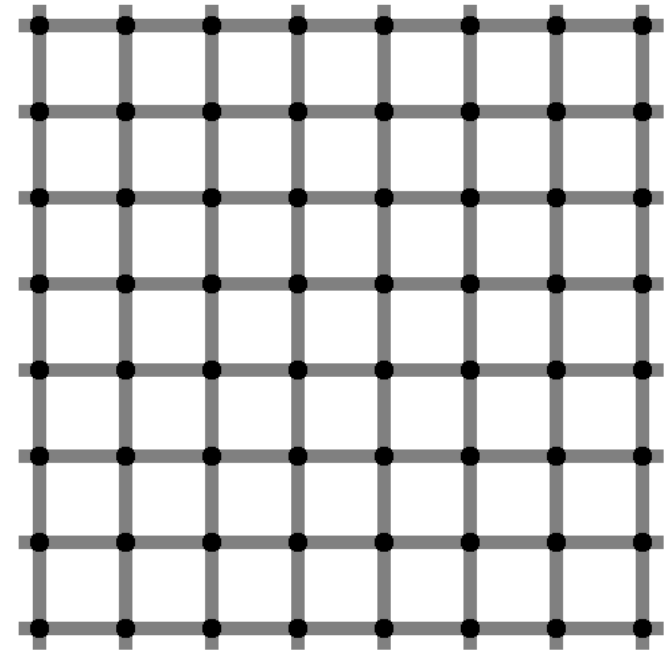
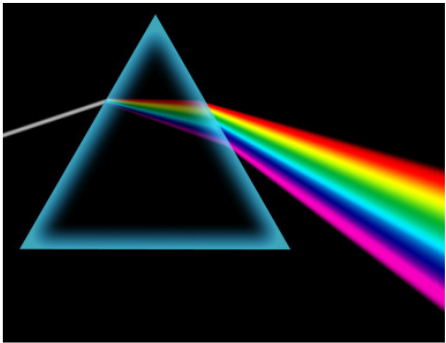
Infocommunication

Light and vision



Tamás Csapó

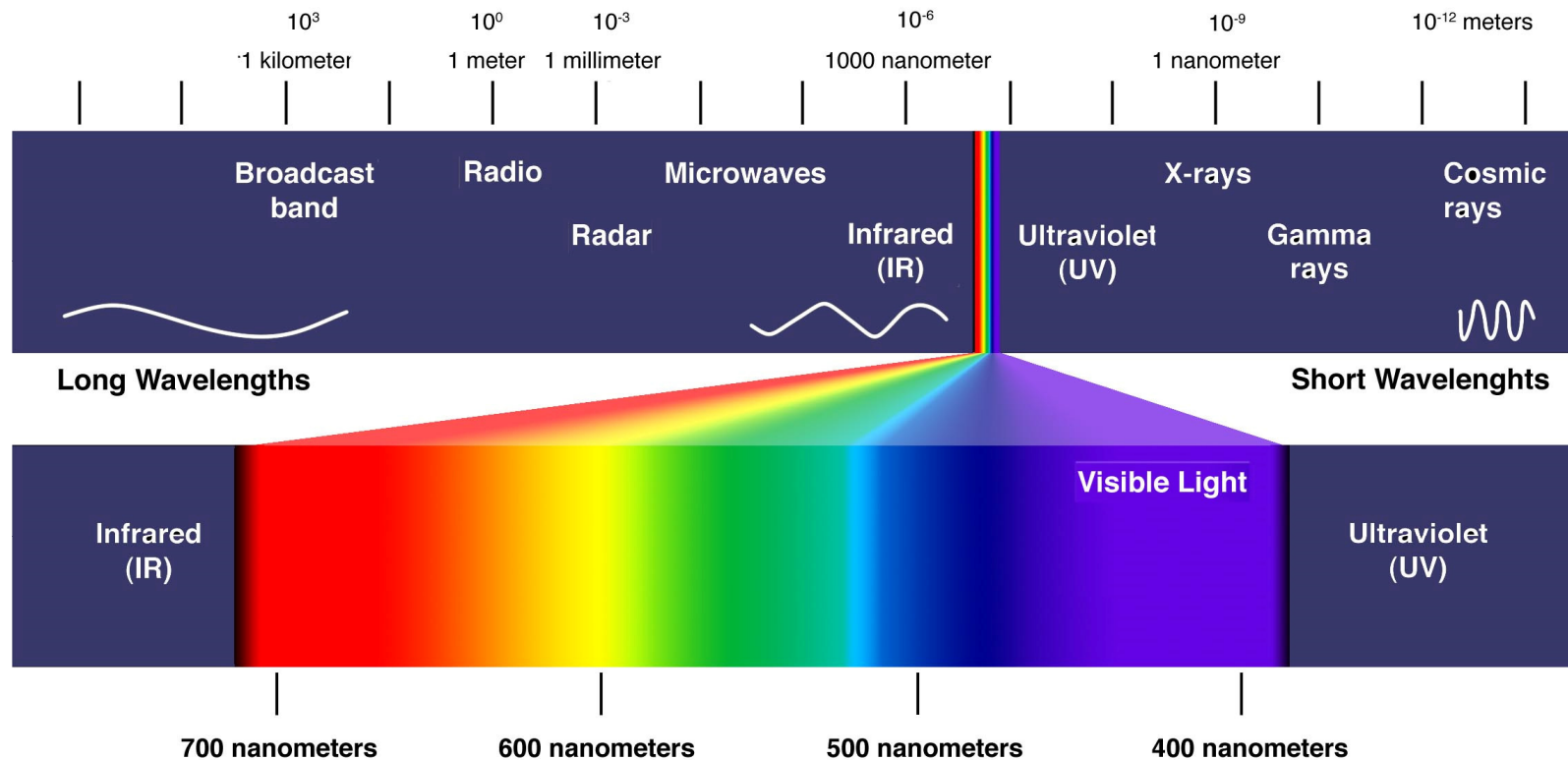
<csapot@tmit.bme.hu>



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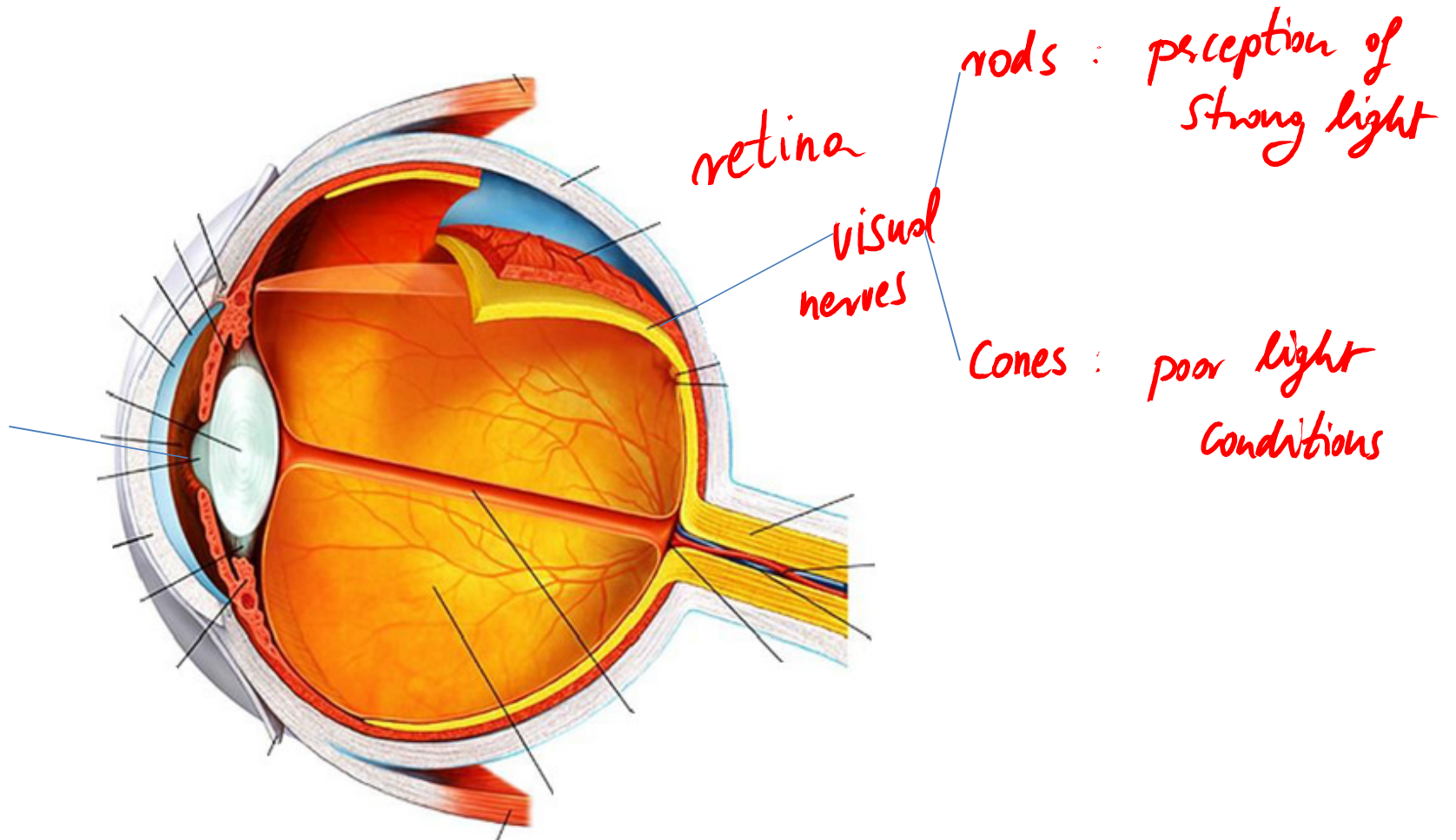
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Electromagnetic spectrum



Source: <http://www.astronomersgroup.org/images/EMspectrum.jpg>

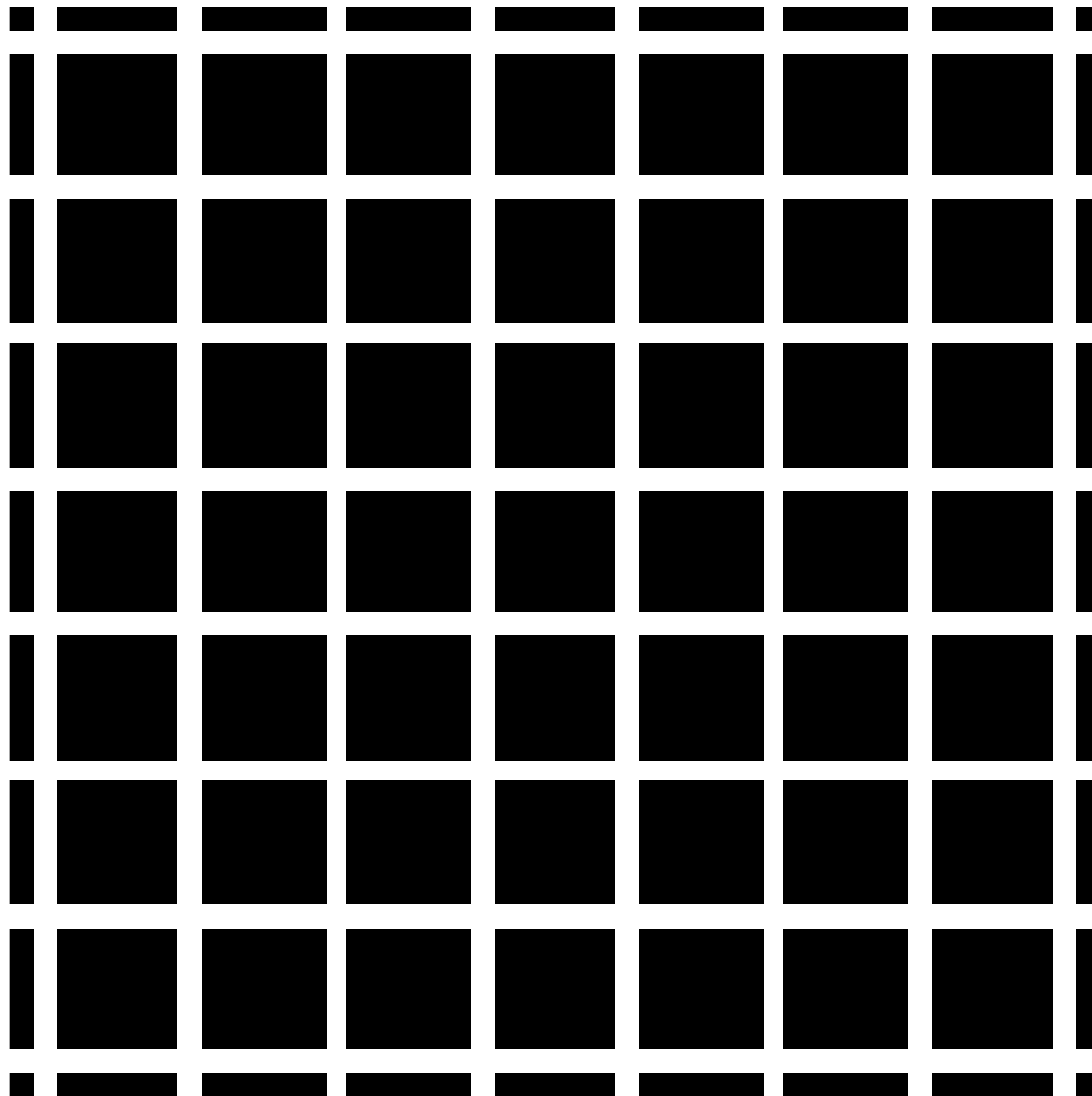
Structure of the eye



Source: <http://virtualmedicalcentre.com>

Limitations of the human eye

- Optical illusions
 - <http://www.michaelbach.de/ot/>





Parameters for describing vision

Subjective / perceptual

Objective / measurable

lightness

luminance

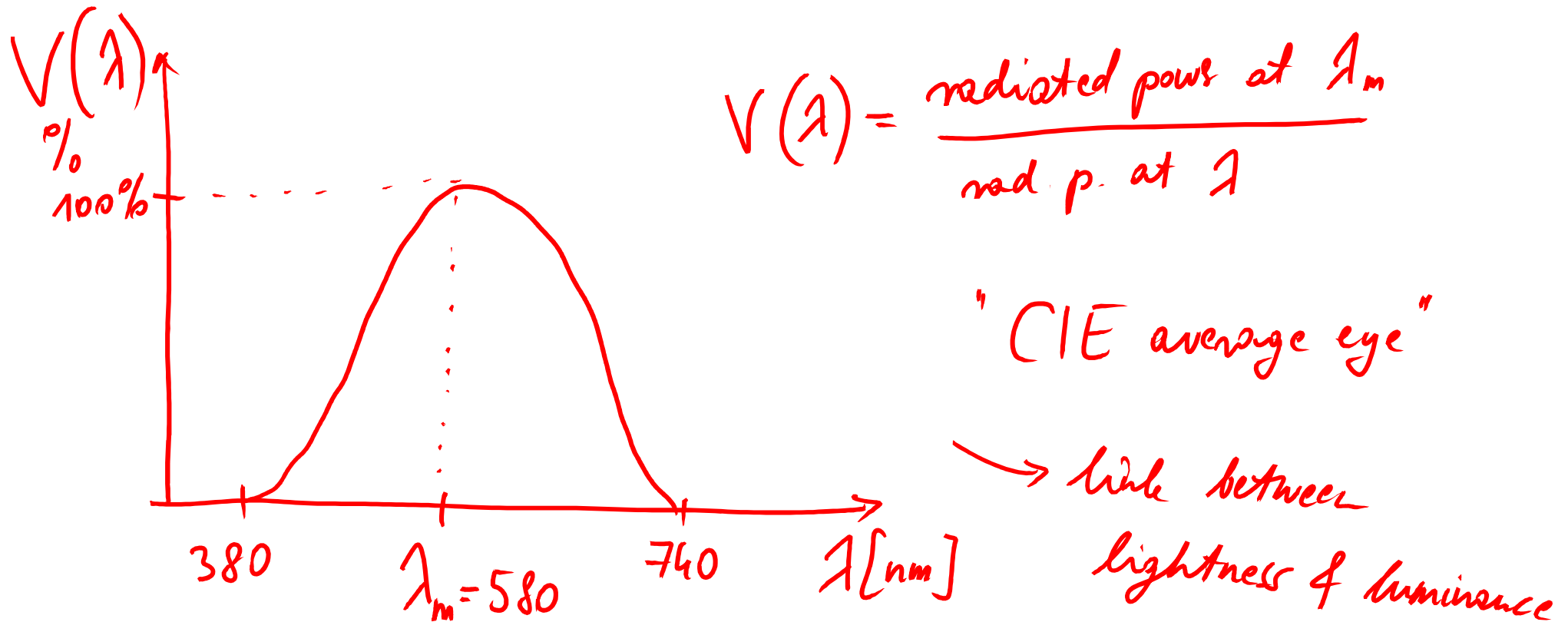
hue (red, yellow, green, ...)

λ , dominant wavelength
monochrome colors · only 1 freq. component

colorfulness/saturation
(light, dark, pastel, ...)

spectral color content

Relative response of the human eye to monochromatic light



Comparative color measurement

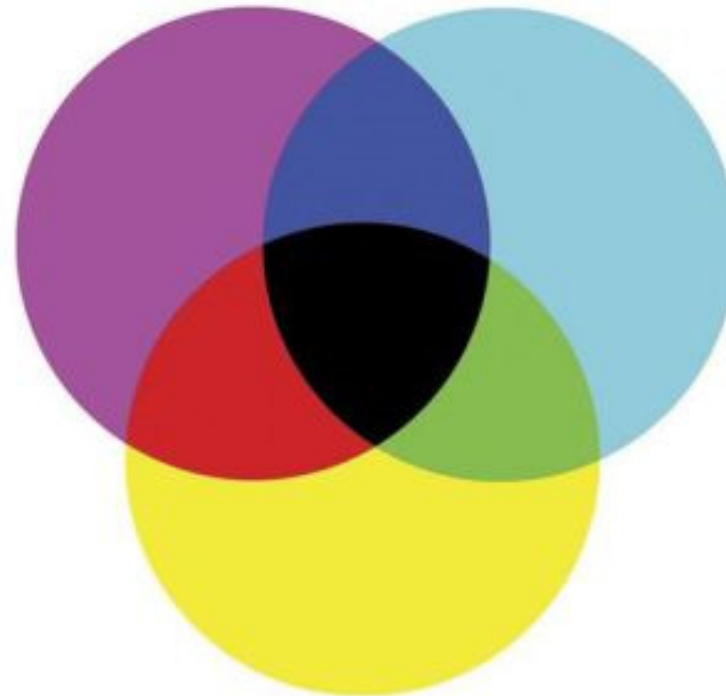
white light spectrum: equal at all freqs

Additive color mixing
3 well chosen colors

Additive and subtractive color mixing



Additive color mixing



Subtractive color mixing

Source: <https://www.tvtechnology.com/opinions/additive-and-subtractive-color-mixing>

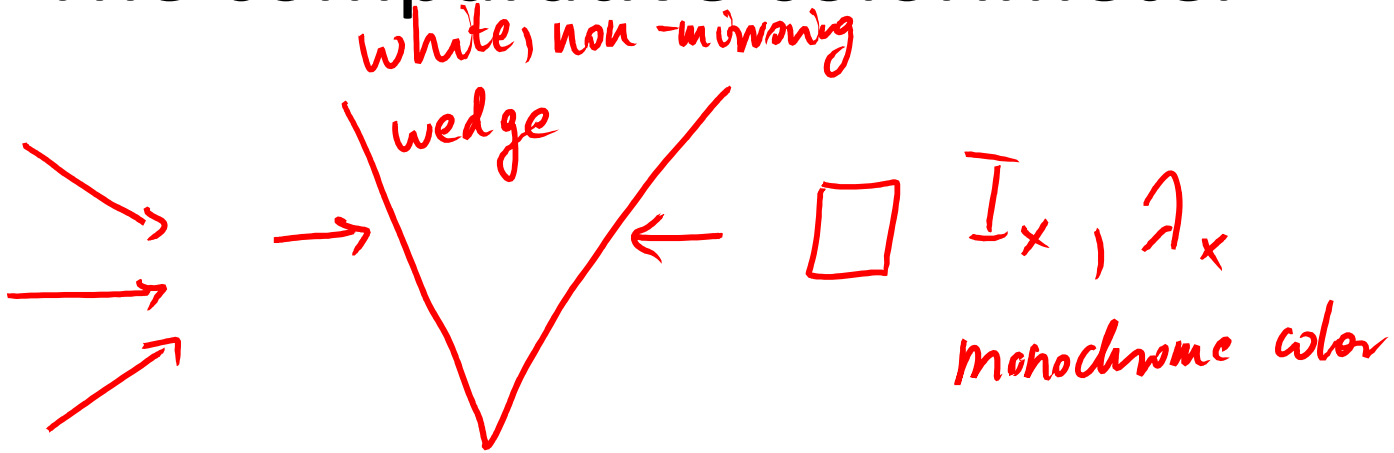
The comparative colorimeter

I_1, λ_1 [R]

I_2, λ_2 [G]

I_3, λ_3 [B]

3 light sources

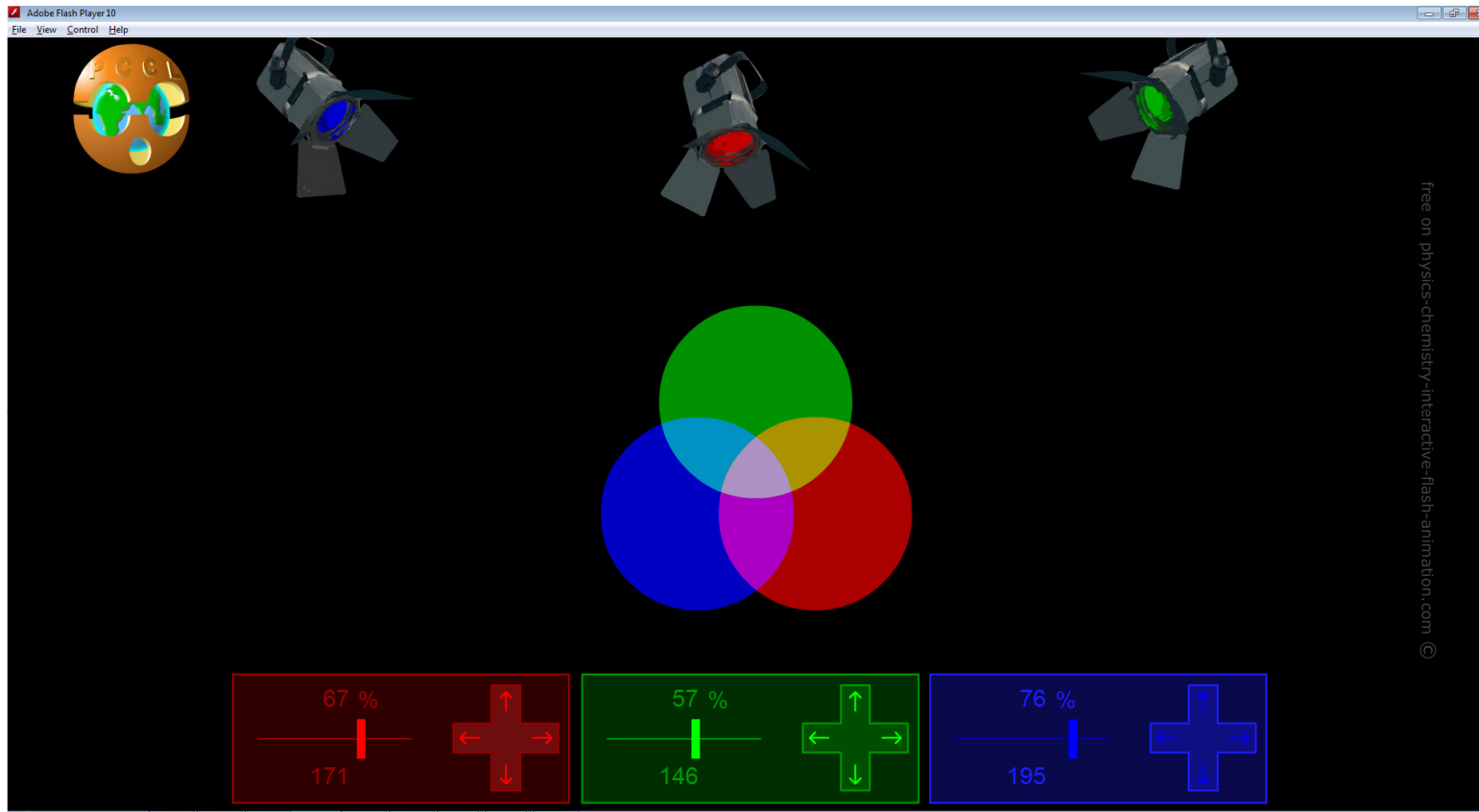


any color can be mixed from
the 3 sources! R-G-B

eye of the observer

Color mixing

- http://www.physics-chemistry-interactive-flash-animation.com/optics_interactive/additive_color_model_mixing_synthesis.htm



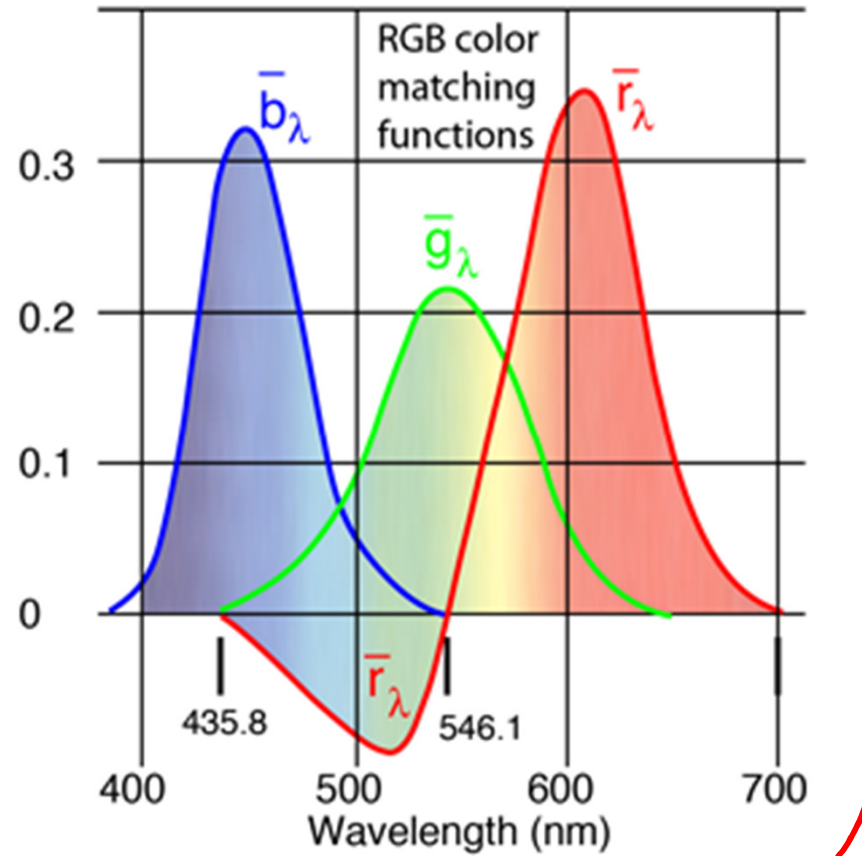
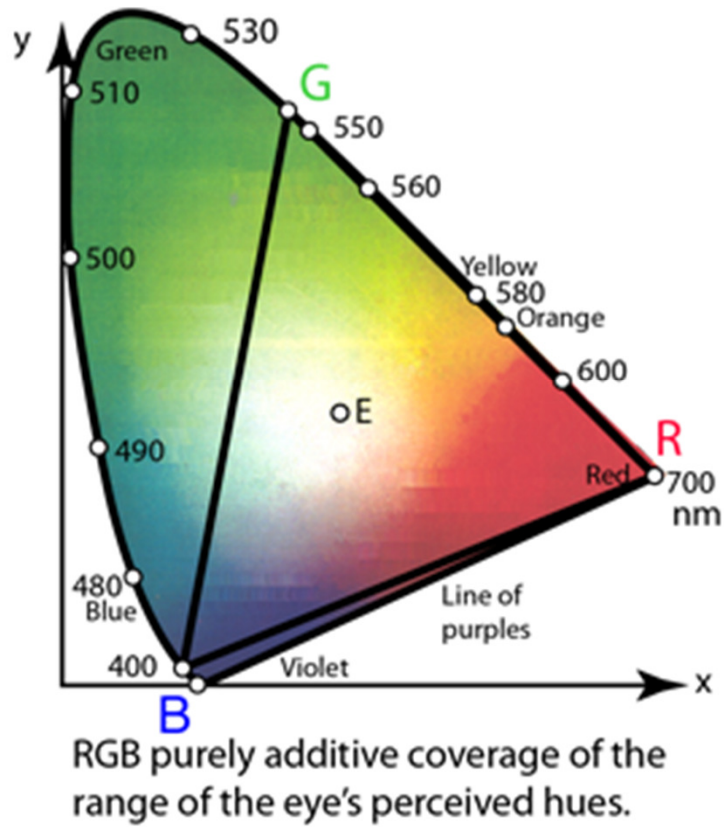
Isochromatic colors

Colors with different spectral content
seem to be the same by our vision

\Rightarrow R-G-B can be used

Luminance

$$Y = 0.3 \cdot R + 0.59 \cdot G + 0.11 \cdot B$$



Source: <http://hyperphysics.phy-astr.gsu.edu/hbase/vision/colspa.html>

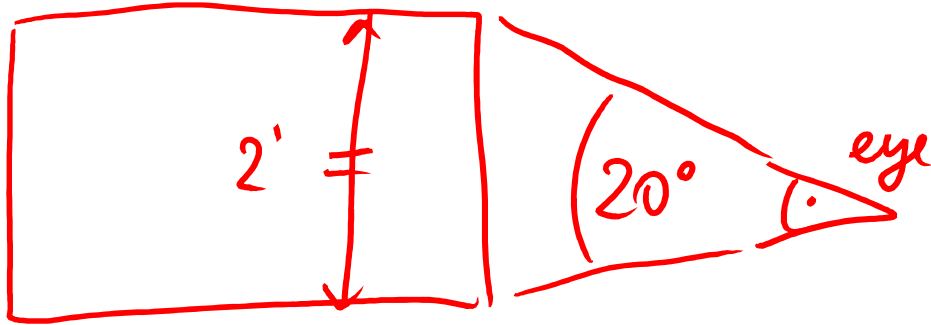
The picture

pixels - optimal resolution?

$$2' = \frac{2}{60}^\circ$$

- if 2 light sources are within $2'$,
the eye can't differentiate them

- if 2 color light s. $10'$,
the eye can't differentiate the color



$$\frac{20^\circ}{2'} = \frac{20 \cdot 60'}{2'} = 600 \text{ pixels}$$

optimal aspect ratio: 4:3

} 800 x
600
Pixels

Optical illusions

- Stepping feet
 - <http://www.michaelbach.de/ot/mot-feetLin/index.html>
- Motion Induced Blindness
 - <http://www.michaelbach.de/ot/mot-mib/index.html>
- Stereokinetic Effect
 - <http://www.michaelbach.de/ot/mot-ske/index.html>
- Scintillating Grid
 - http://www.michaelbach.de/ot/lum_scGrid/index.html
- Hinton's "Lilac Chaser"
 - <http://www.michaelbach.de/ot/col-lilacChaser/index.html>
- Watercolor Illusion
 - <http://www.michaelbach.de/ot/col-watercolor/index.html>
- Tilted Table Illusion
 - <http://www.michaelbach.de/ot/ang-tiltedTable/index.html>

The END

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