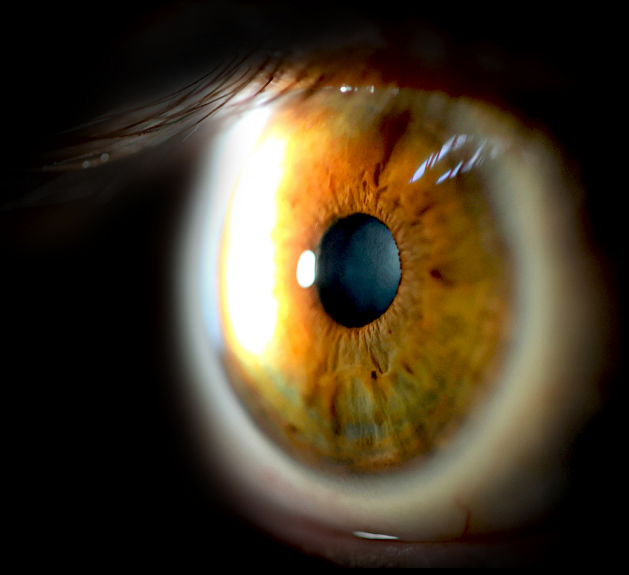
Comparing the
Camera and the Eye

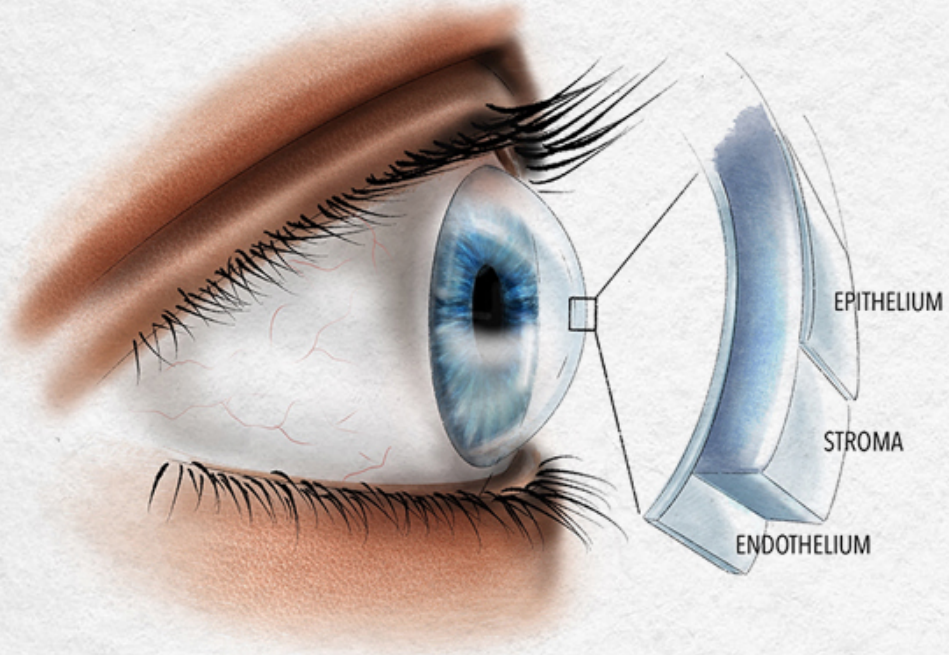
Brian MacNab

29th April 2024



Clarity

Clear Cornea/Ocular Media



Anti Reflection Coatings

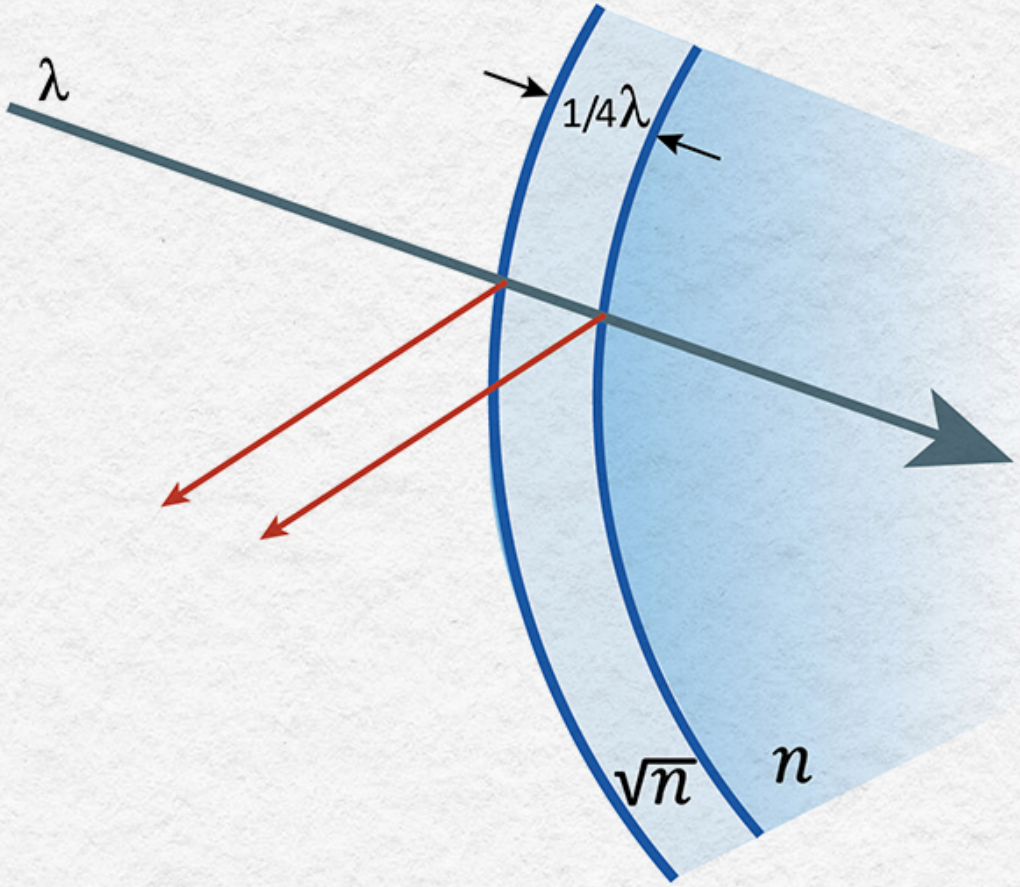
Anti-Reflection Coating

Anti Reflection Coatings

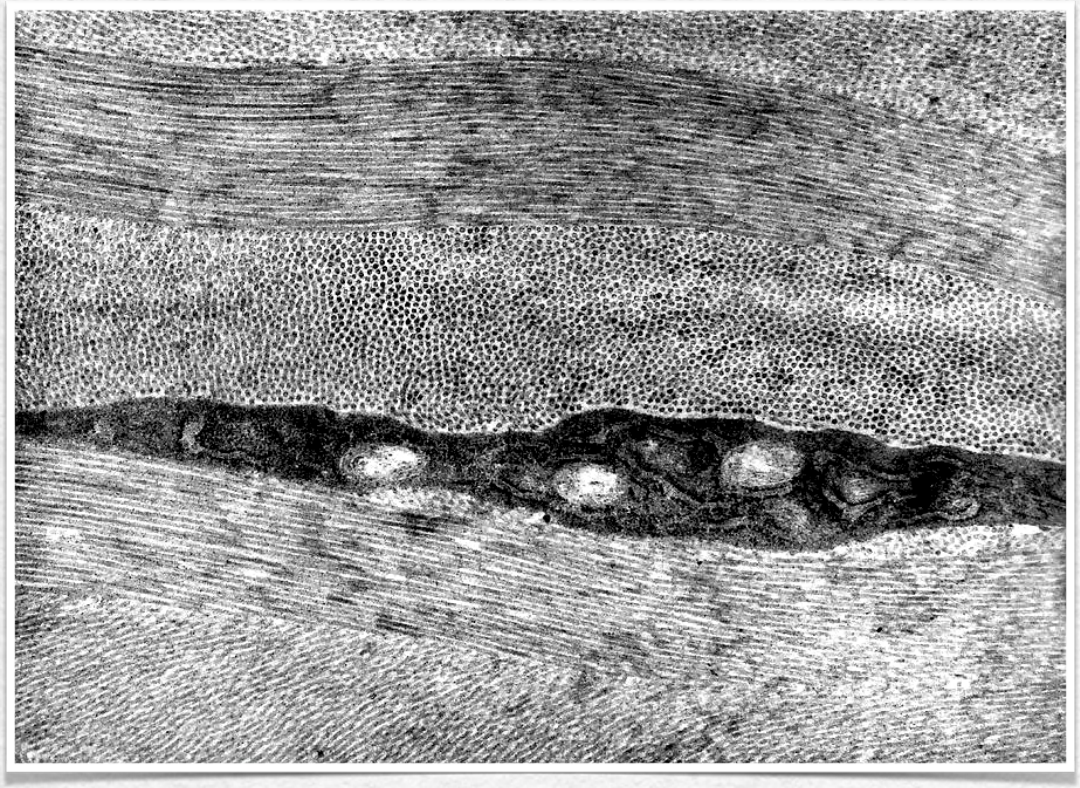
Reflected light (red) half a wavelength out of phase.

Destructive interference of reflected light

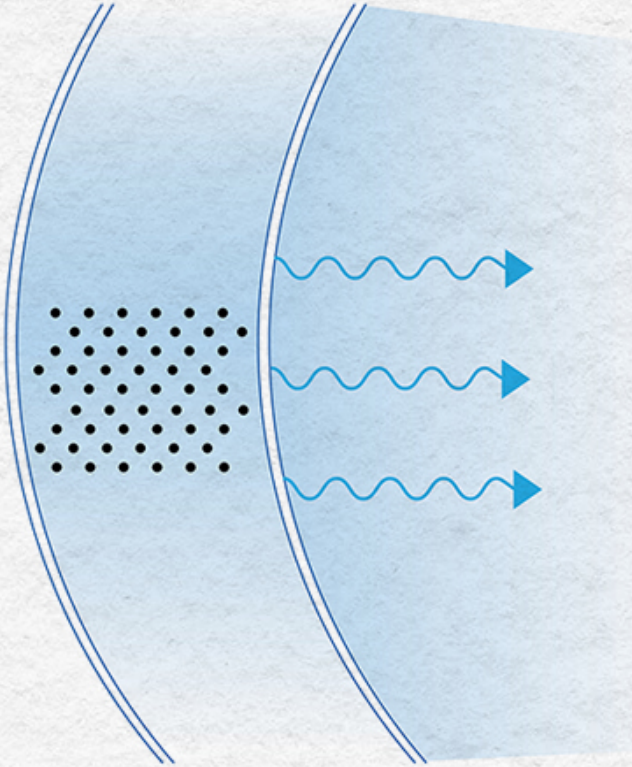
More light passes through system



Corneal Clarity



Stromal fibres in regular lattice



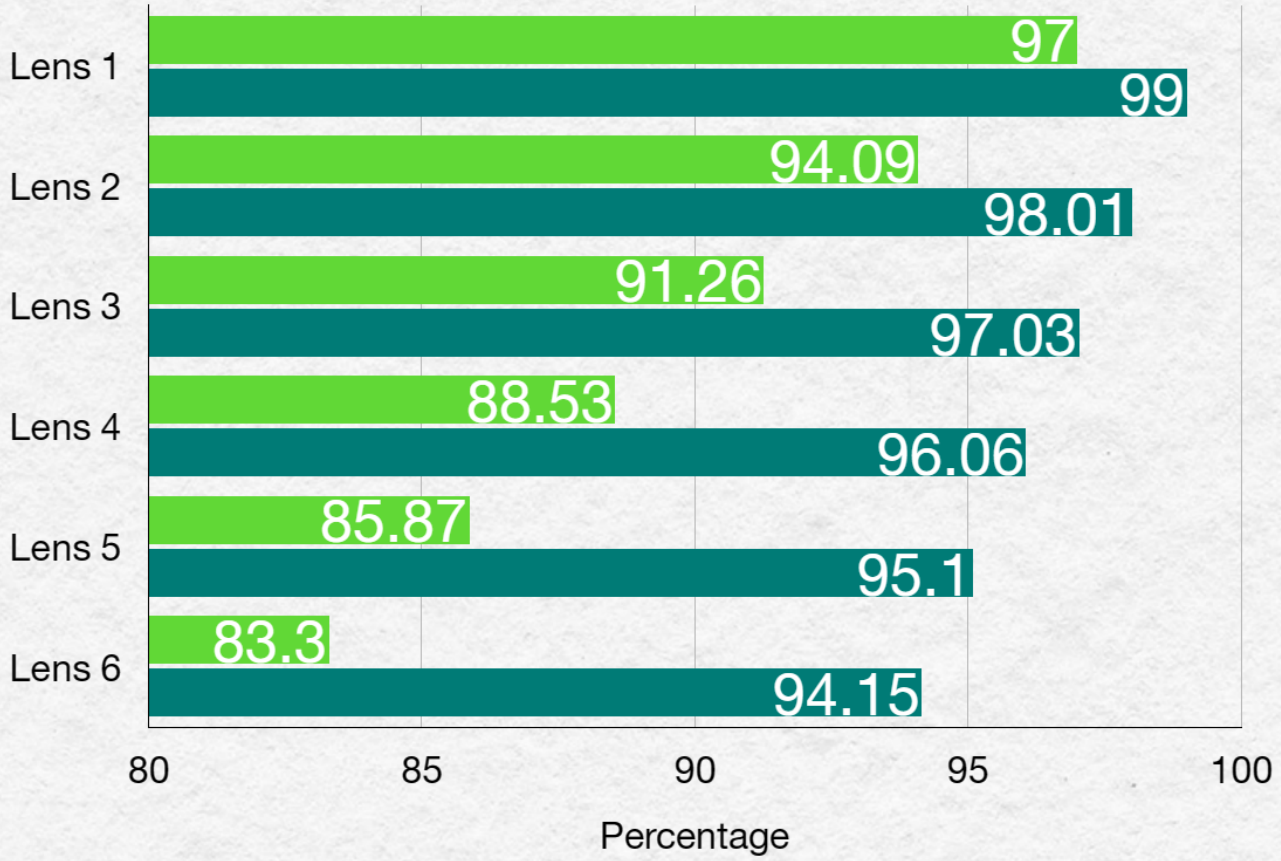
Endothelium removes water from stroma

Does A/R Coating Help ?

Comparing

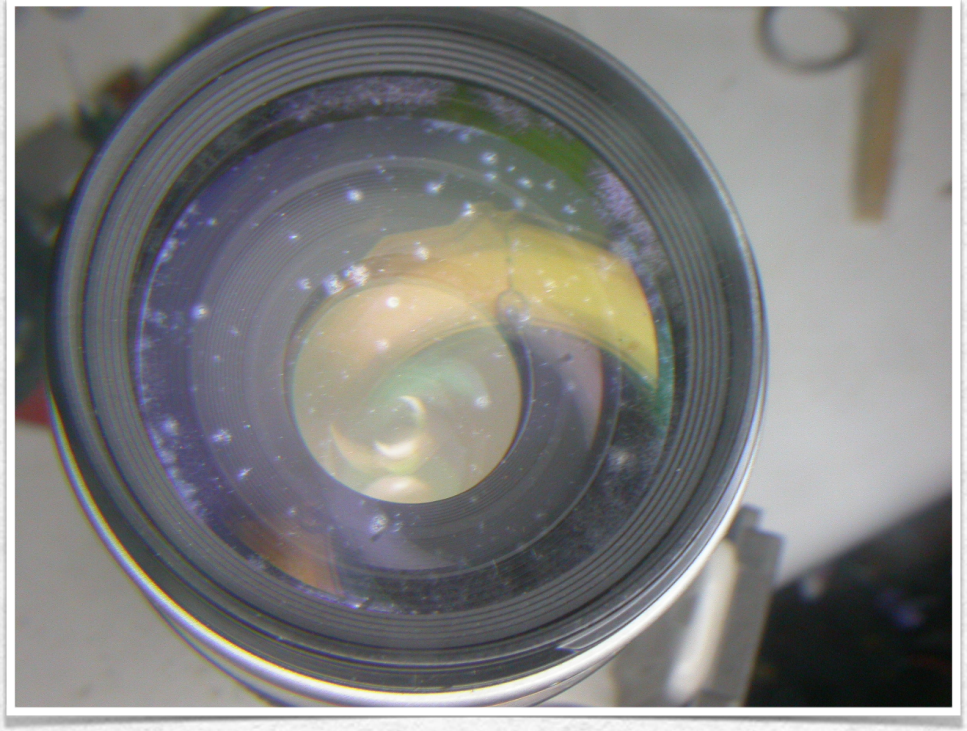
- Uncoated Lens 3%
- Coated Lens 1%

10% more light transmitted after 6 surfaces.



Fungus on Camera Lenses

Spots of fungus degrade visual quality



Cataract

Age **Occupation** **Trauma**

Aperture

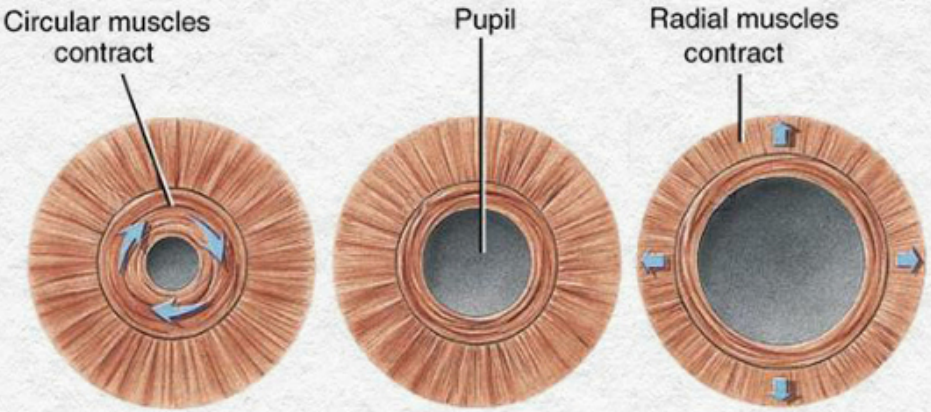
Diaphram

Multi bladed leaves form aperture

Bright Light Normal Light Dim Light

Pupil

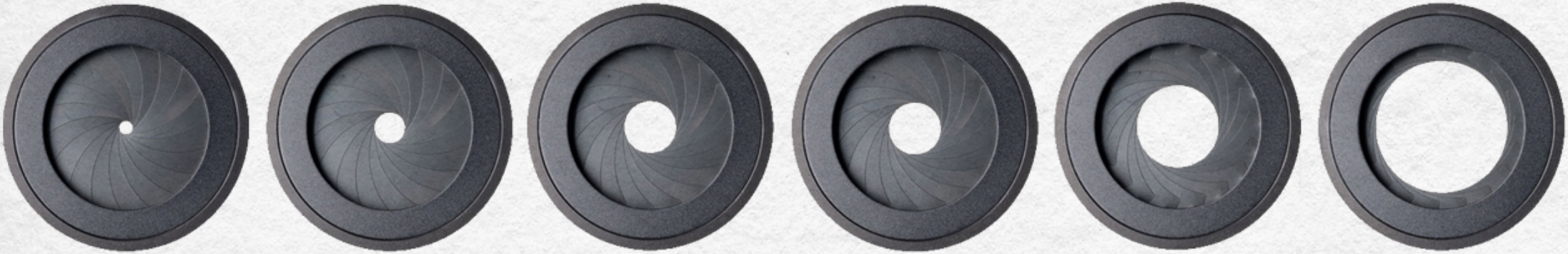
Controlled by muscles in Iris



Bright Light Normal Light Dim Light

Camera

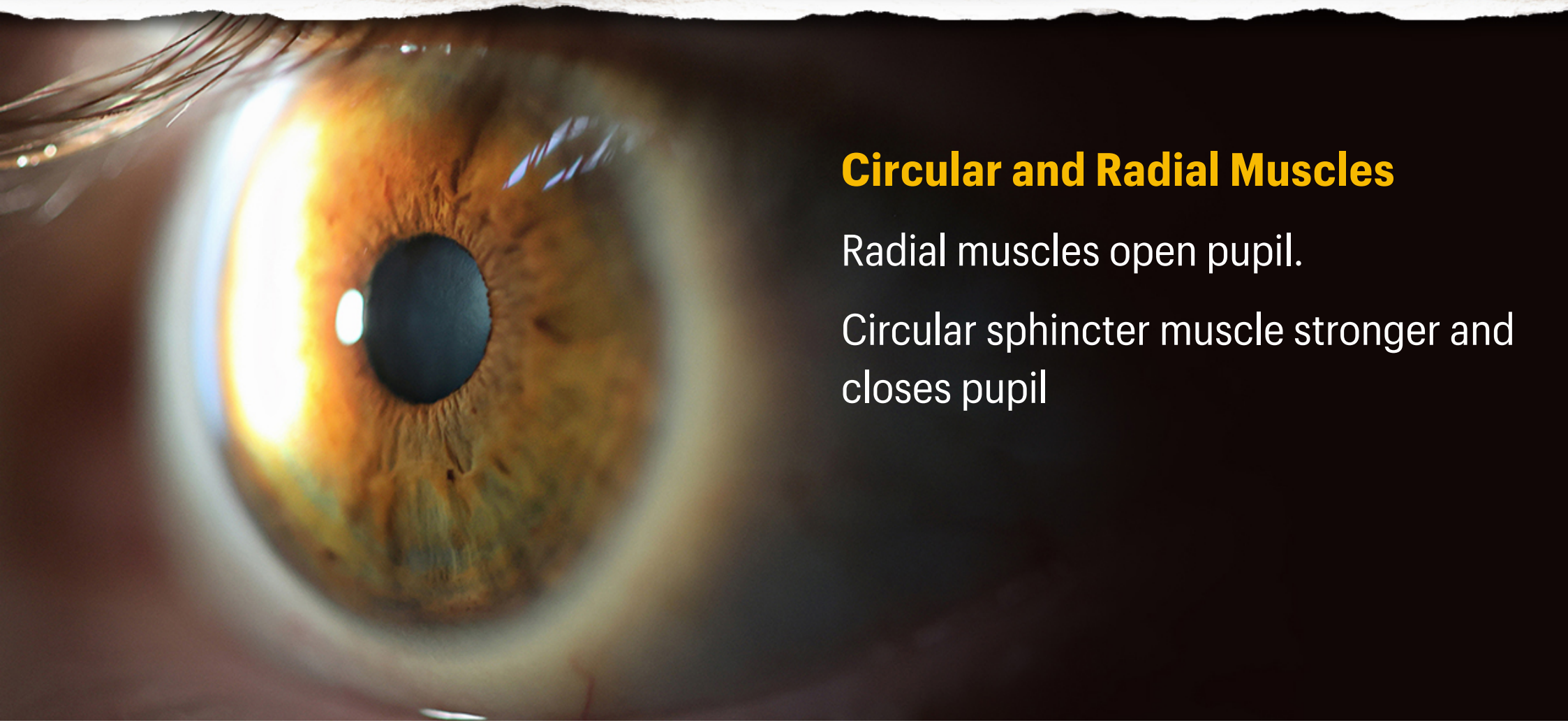
Multi leaf diaphragm



Increased number of leaves improve roundness of out of focus portions.

Aperture is ratio of diameter to focal length.

Eye



Circular and Radial Muscles

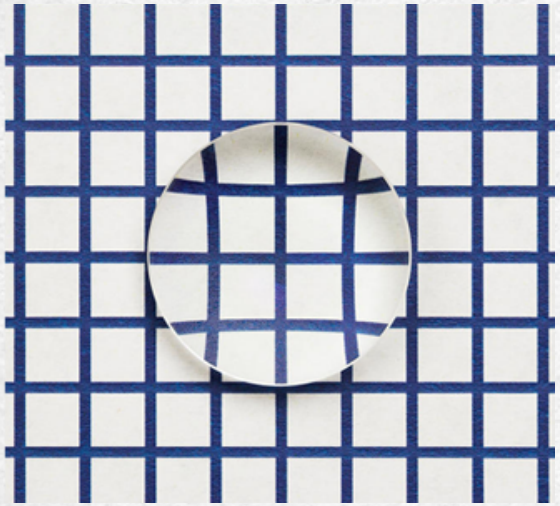
Radial muscles open pupil.

Circular sphincter muscle stronger and closes pupil

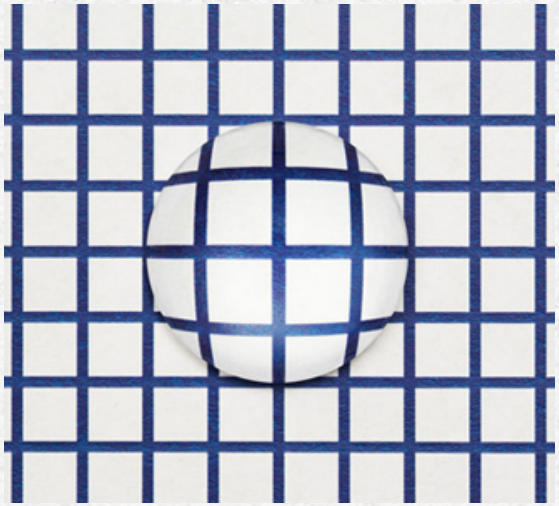
Aberrations

Three Common Types of Distortion

Pincushion Distortion



Barrel Distortion



Chromatic Aberration

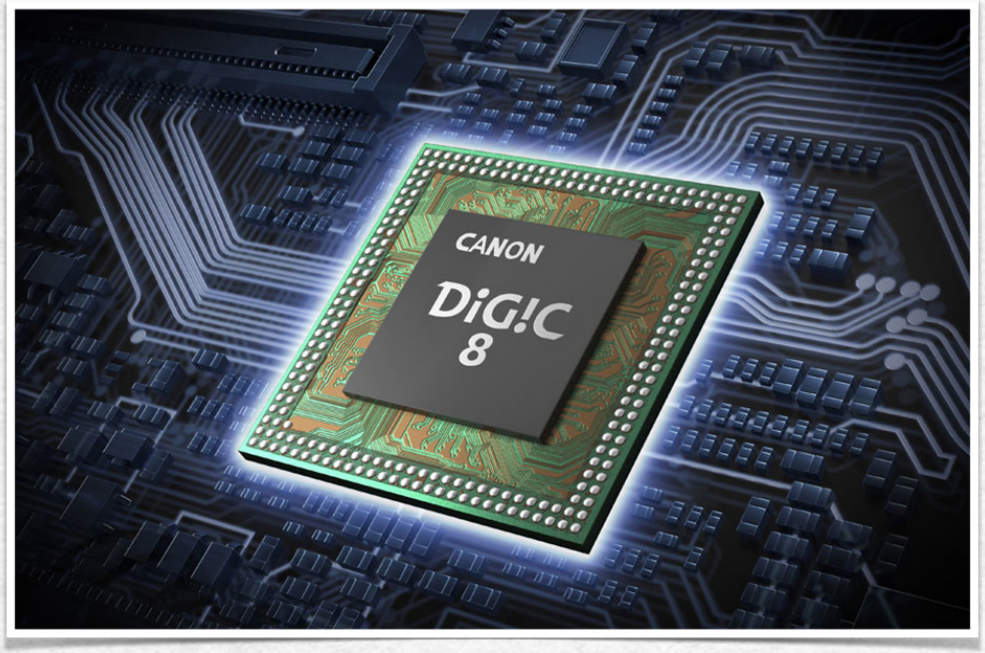
Ocular Aberrations

Oblique Astigmatism & Chromatic Aberration

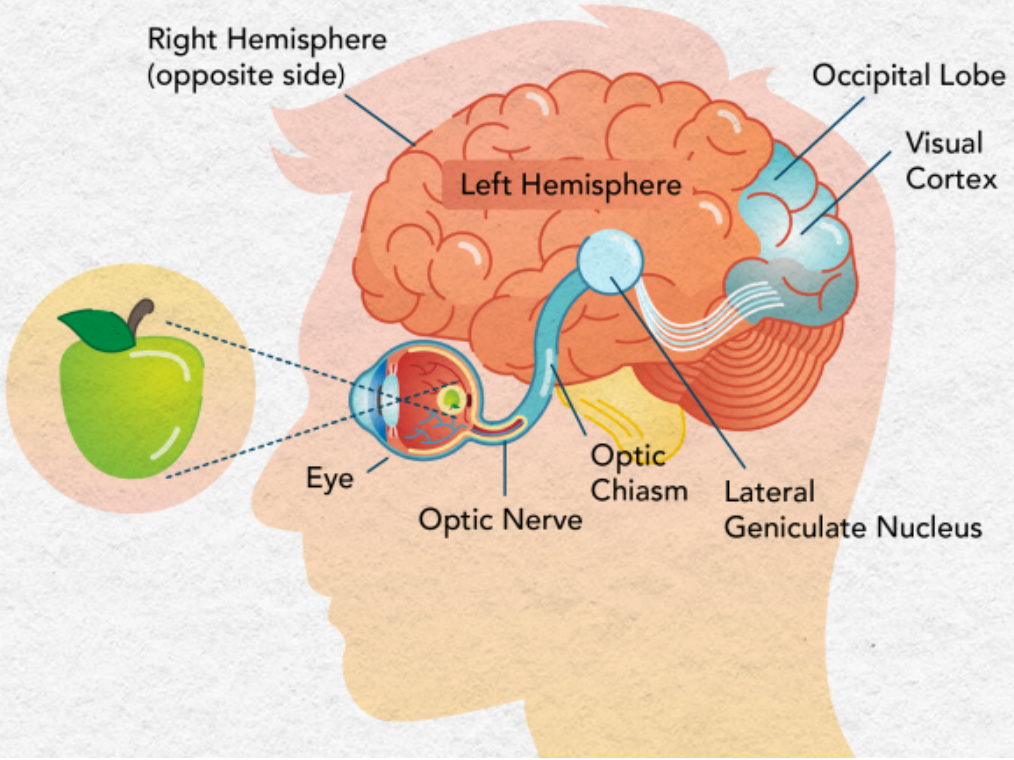
The squares on these glasses are not to scale, but demonstrate how a square would look away from the central axis.

Image Processing

Micro-processor in camera

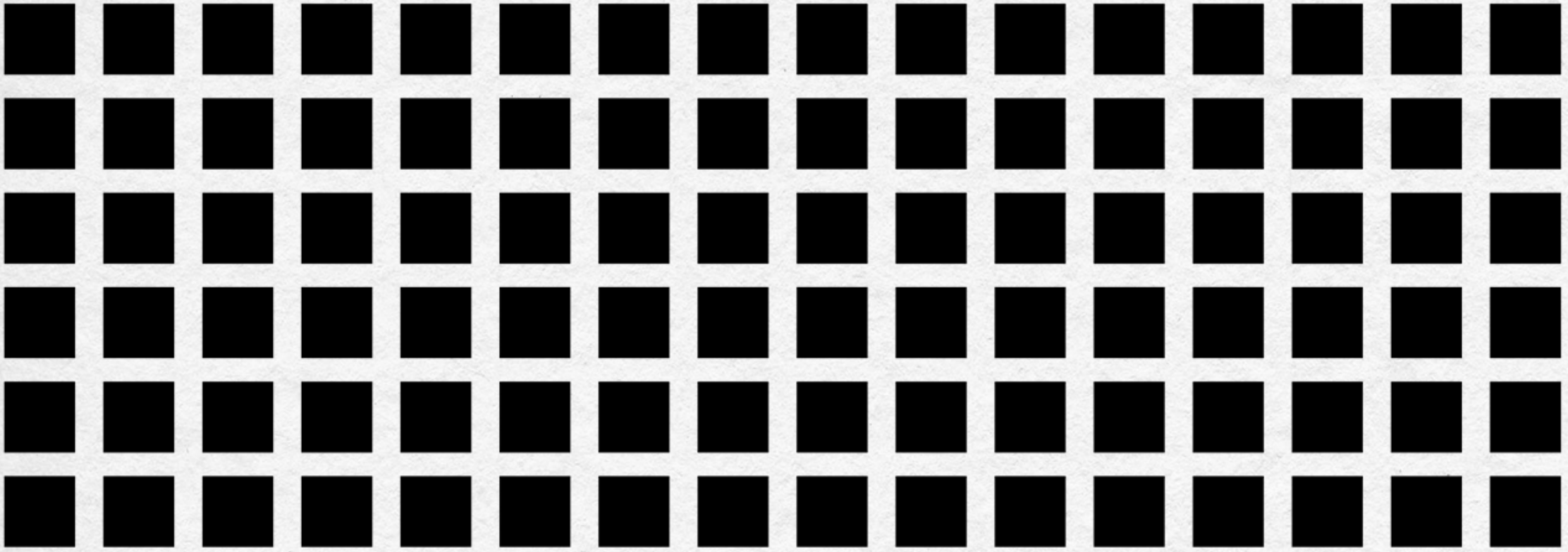


Visual process in eye/brain



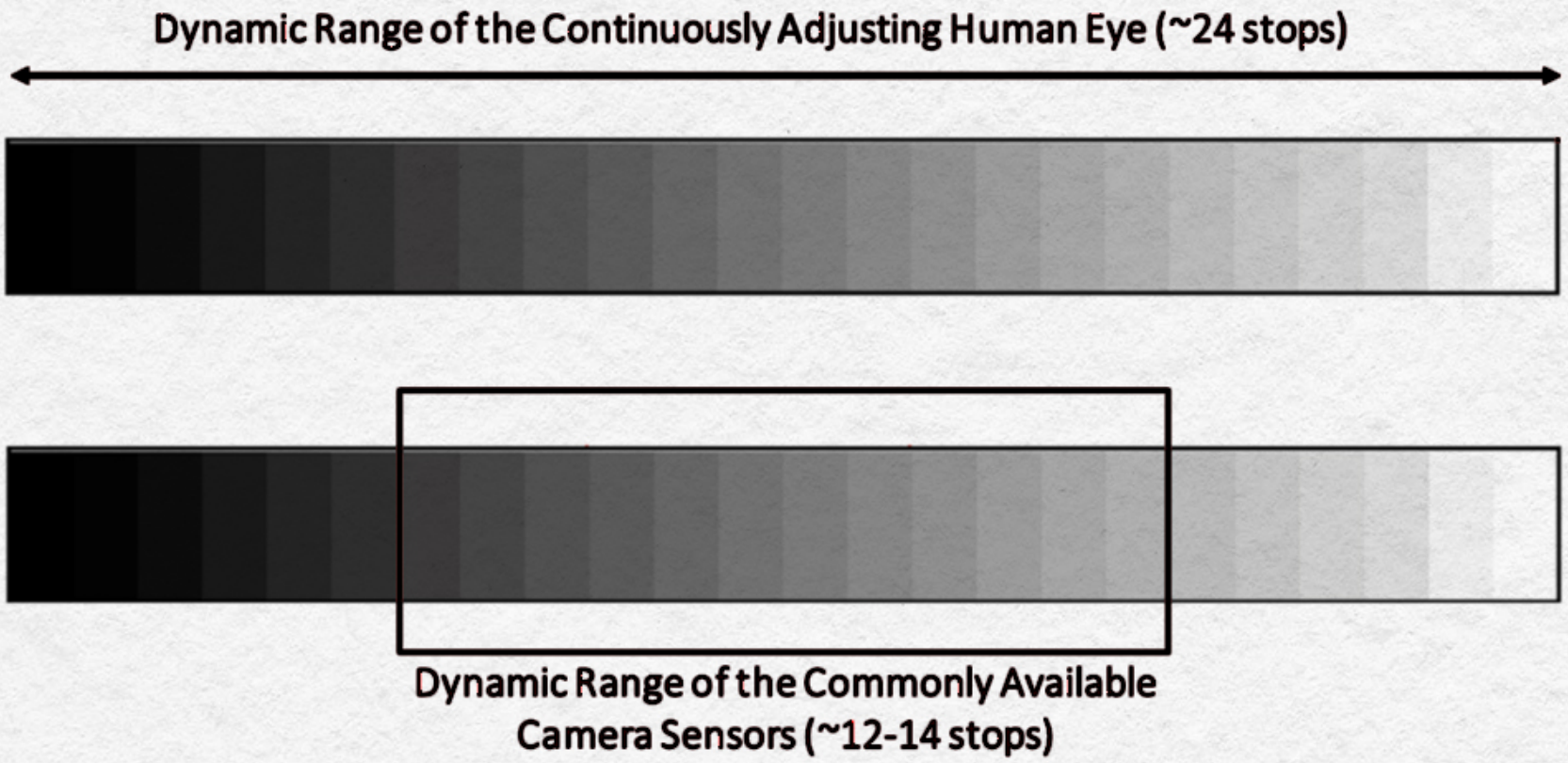
Visual Processing

Some image processing done at eye level in visual system

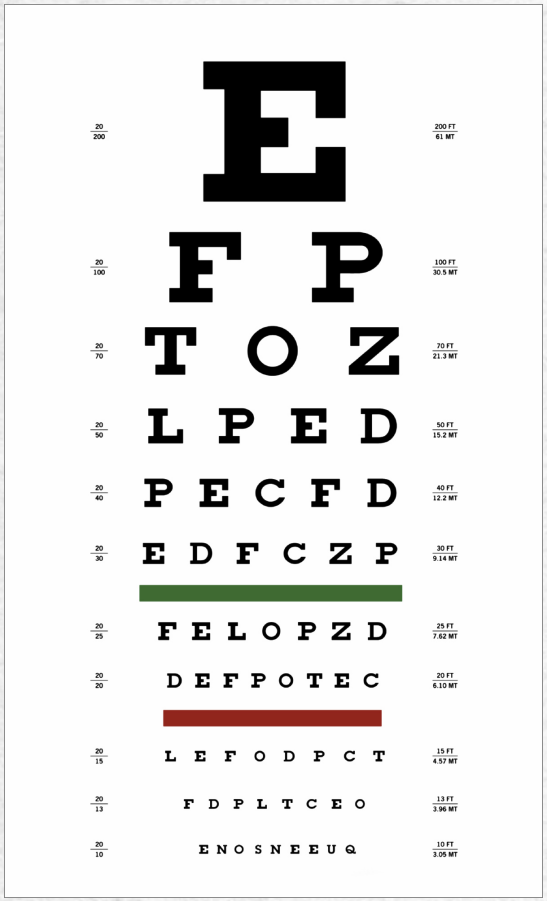


Colour Consistency

Dynamic Range



Sharpness



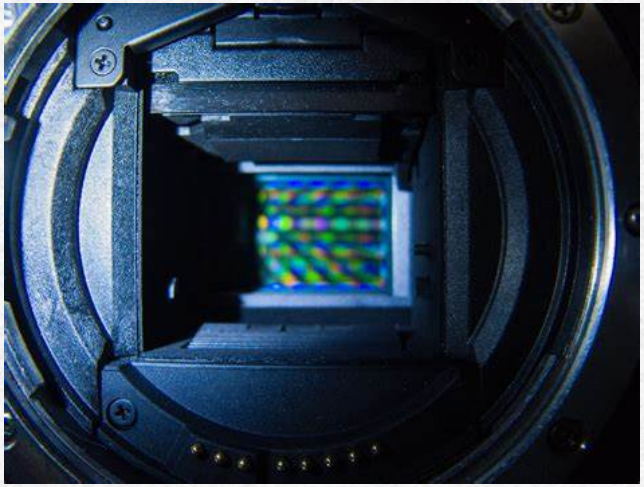
Mega Pixels and the Eye

A mega pixel is one million pixels

50 mega pixels equivalent in the human eye.

Normal human vision 6/5

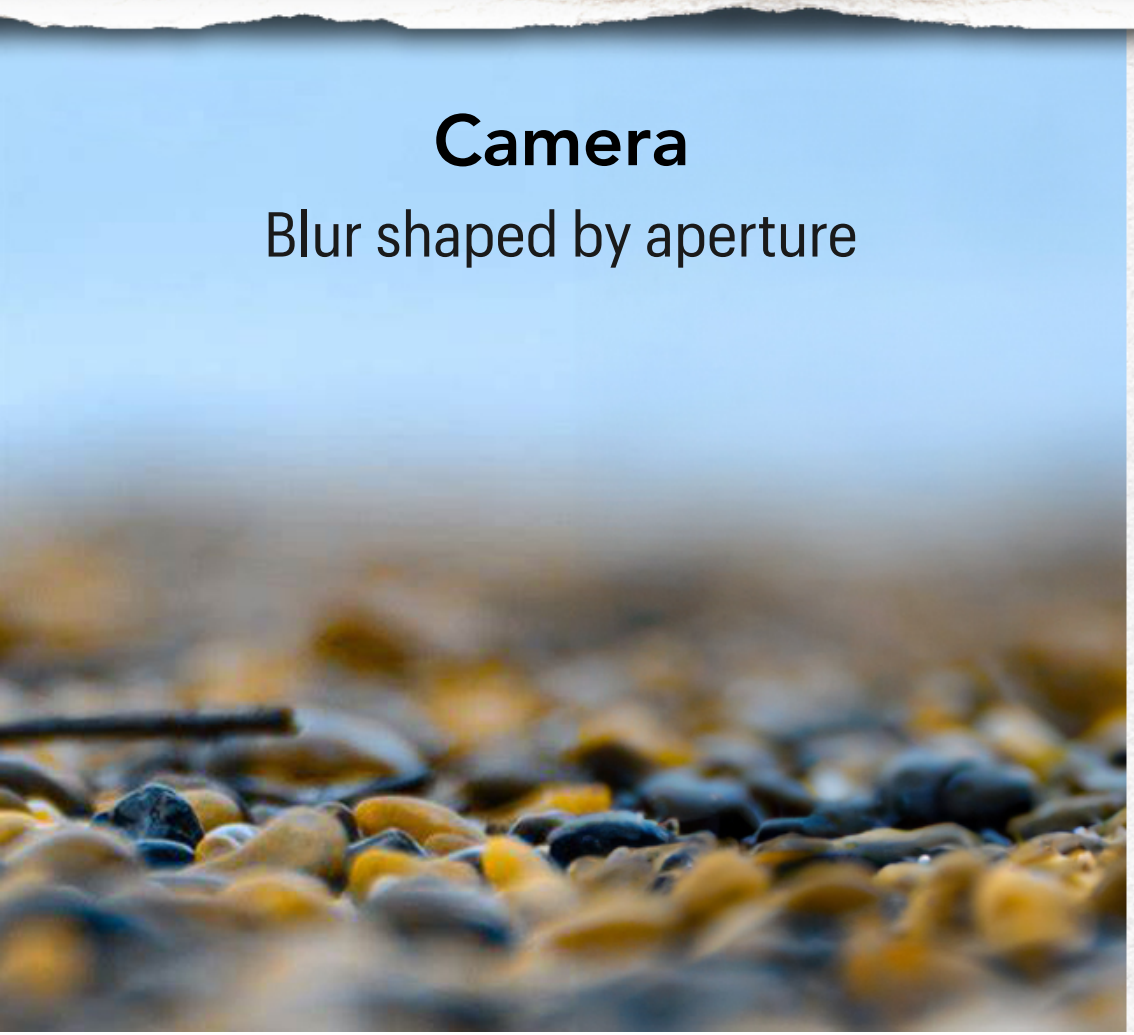
(20/15 U.S. equivalent)



Out of Focus

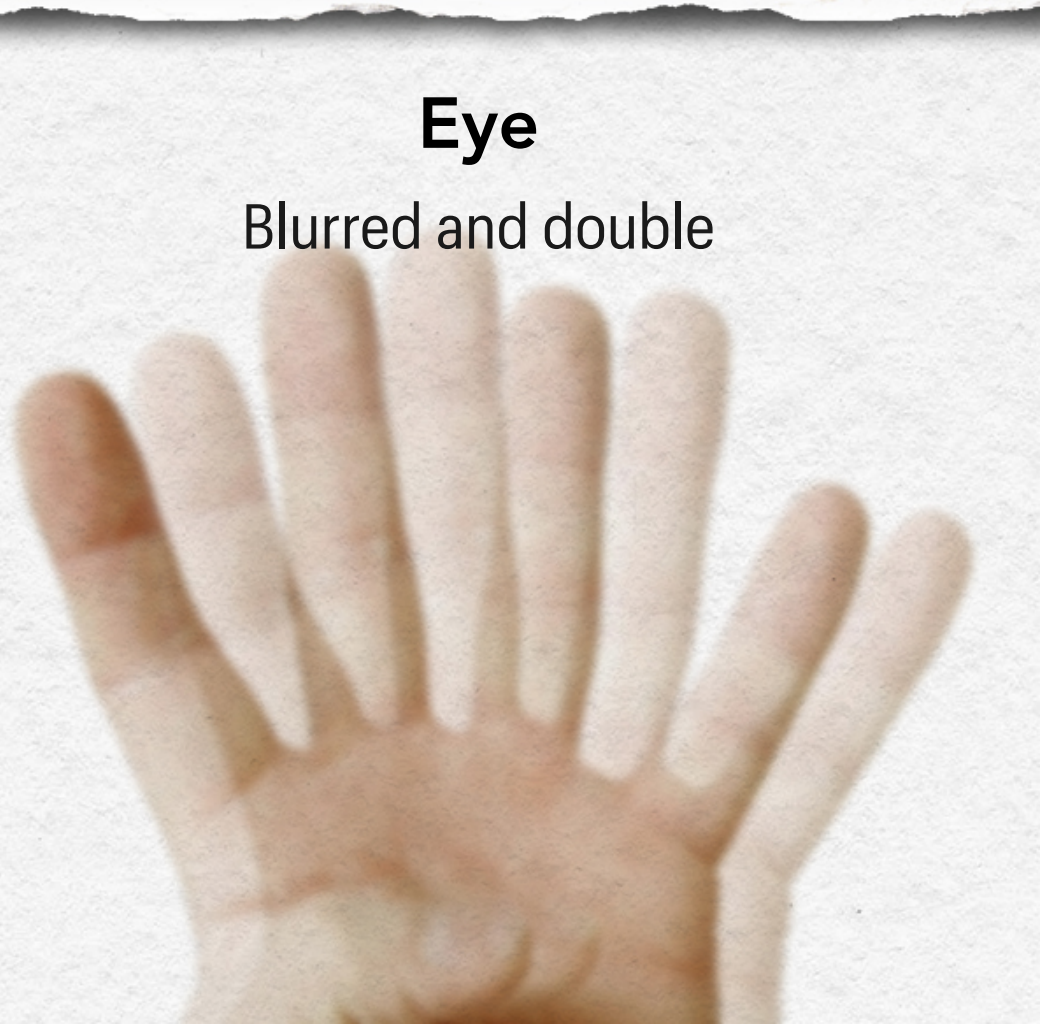
Camera

Blur shaped by aperture



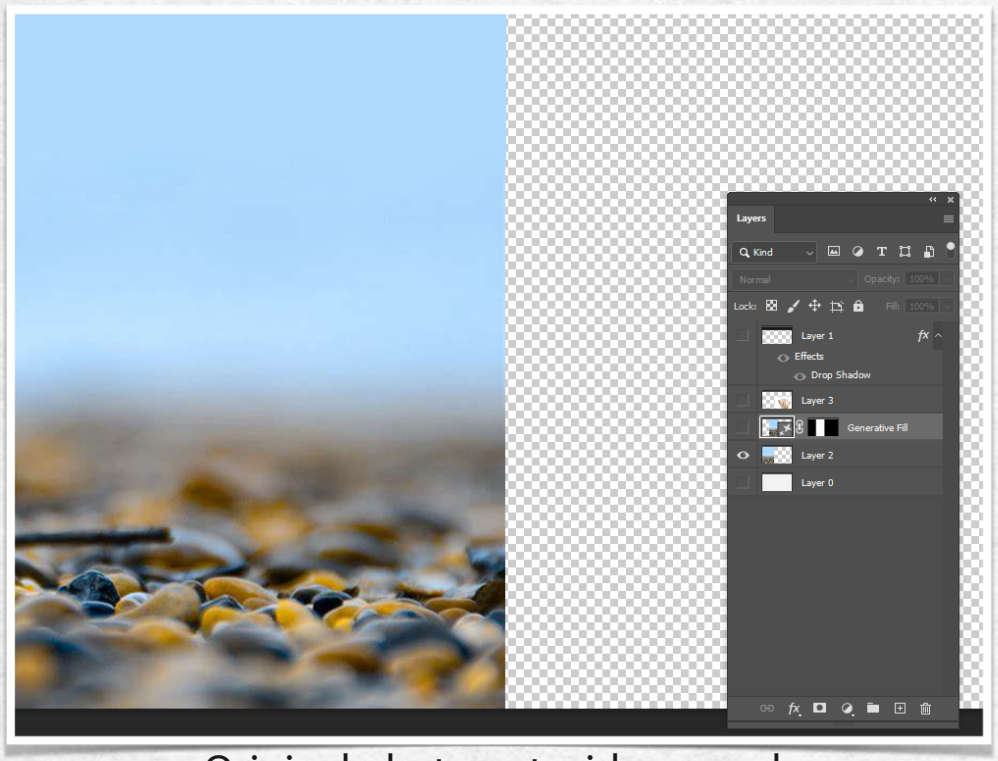
Eye

Blurred and double

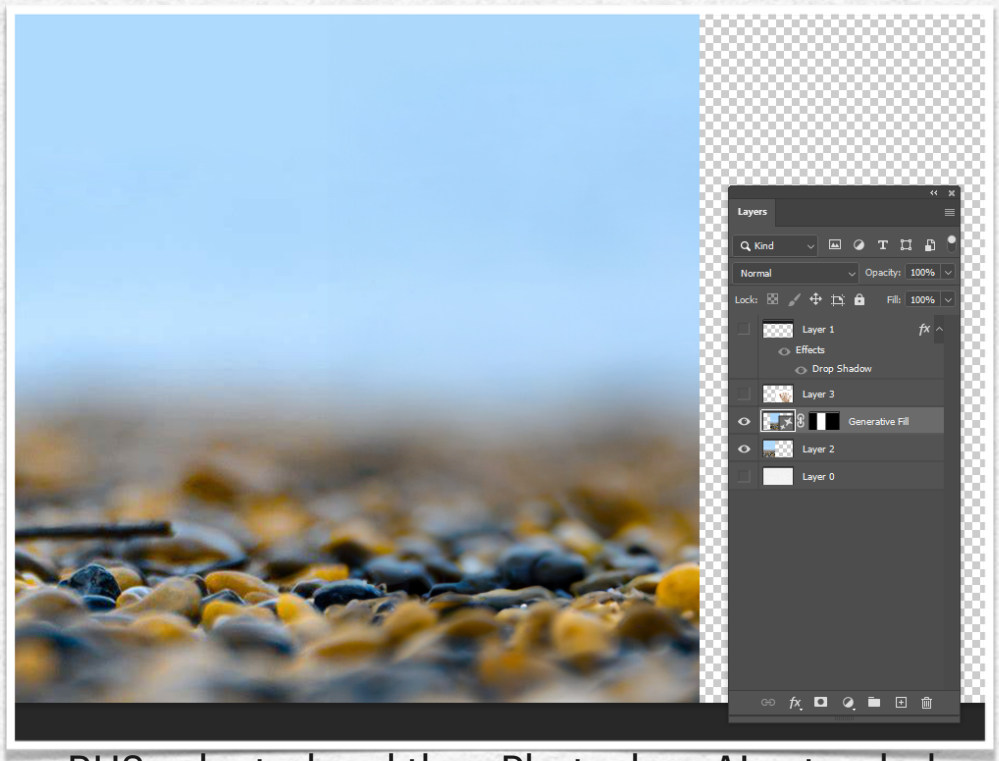


Artificial Intelligence

Generative AI in Photoshop



Original photo not wide enough



RHS selected and then Photoshop AI extended

Negative and Positive Scotomas

Negative scotoma and the blind spot

Negative scotoma is similar to AI with visual system filling in missing areas.

Positive scotoma when visual pathway blocked for example after stroke.

Most humans observers unaware of blind spot normally.

Negative and Positive Scotomas

Hands on session

Hold sheet of paper vertically half way across in front of one eye. This is a **positive scotoma**.

Bring cross on sheet in towards one open eye in a straight line. Circle will disappear. This is a **negative scotoma.**

Prism

Eye movements

Eye has ability to cope with large movements horizontally but very little vertically.

Resilient

Image Inversion

Inverting specs turn image upside down and adapted to within three days.

Three days needed to readapt back to normal

Image Persistence

Stabilised Retinal Image

If eye moves, retinal image moves exactly same amount.

Removes micro-oscillations of eye.

Image fades and disappears after 2 - 3 seconds.

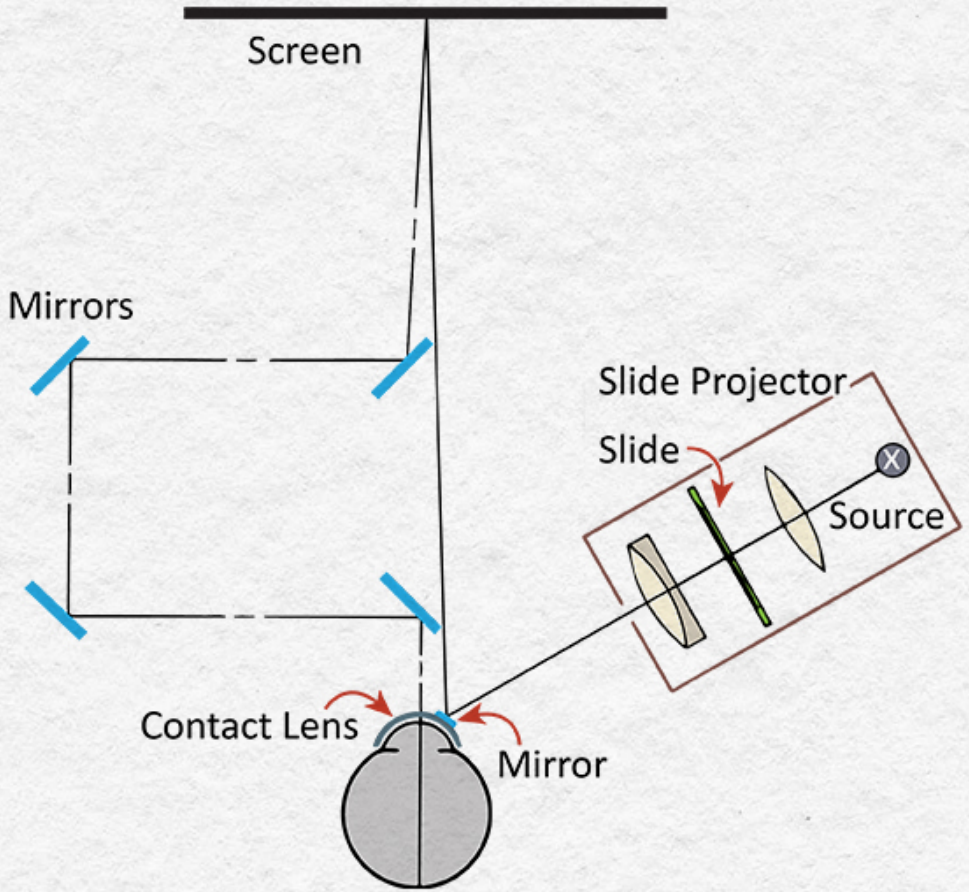
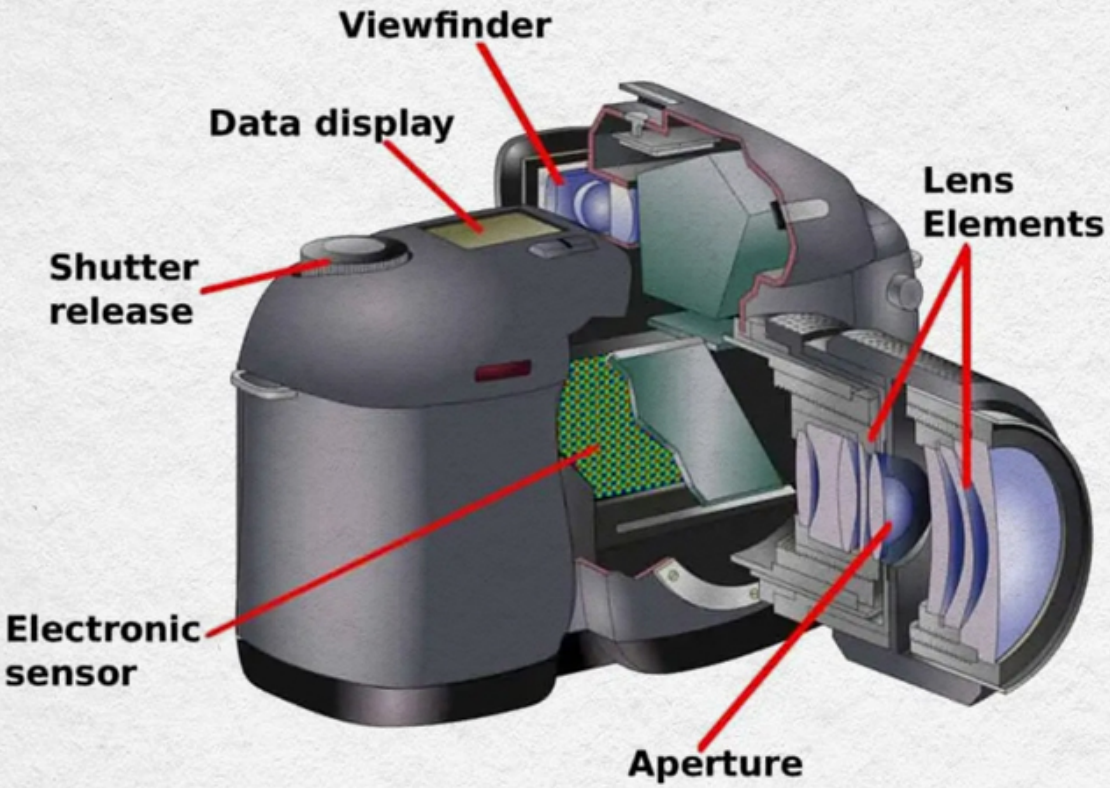
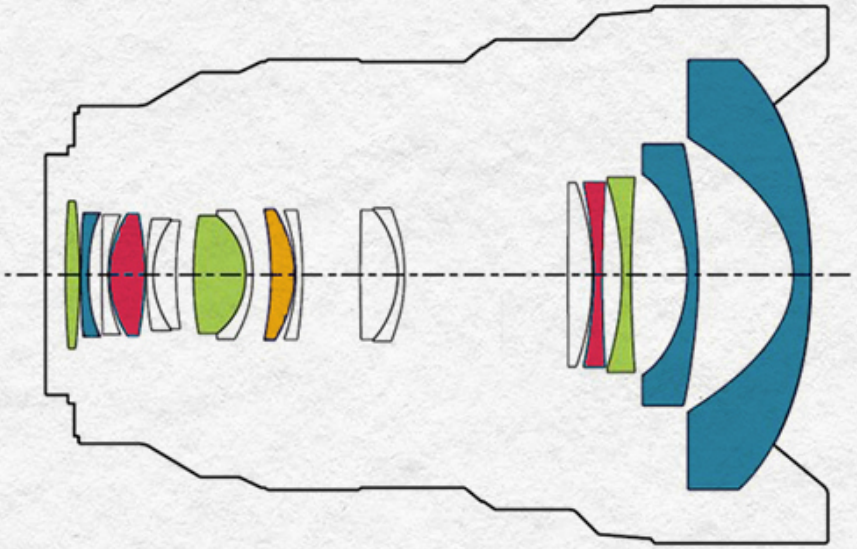


Image accumulation

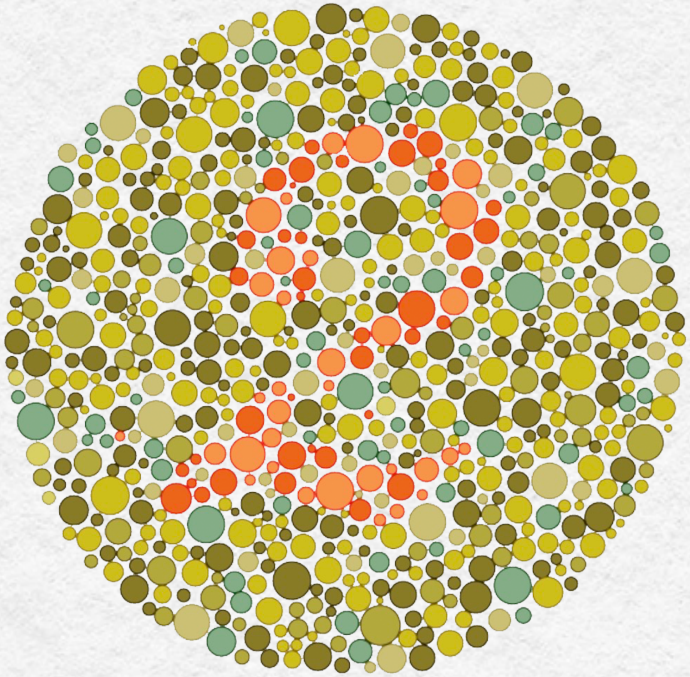




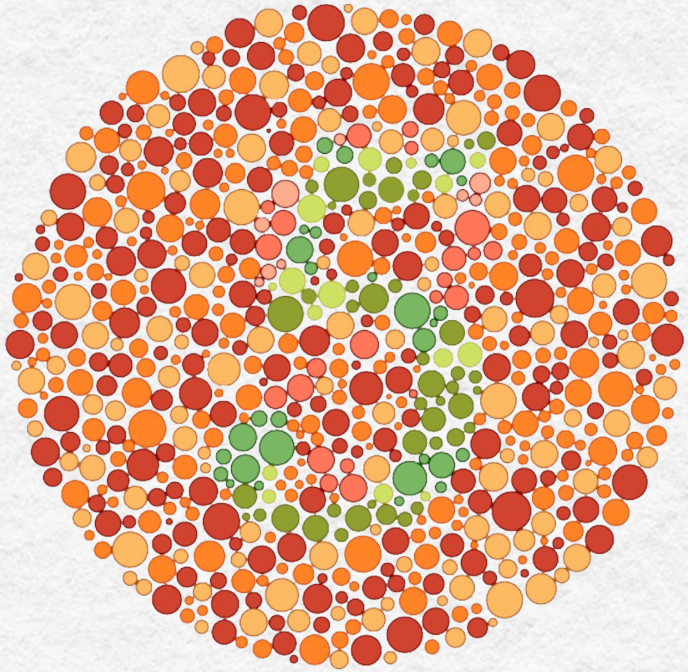
Extreme aspherical lens (XA lens)
Aspherical lens
Super ED (extra-low dispersion) glass
ED glass

Colour Vision

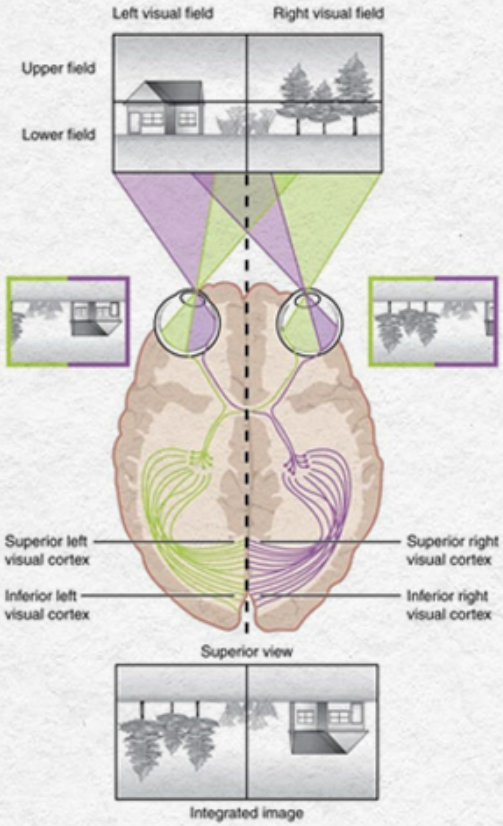
Trichromats.



Anomalous Trichromats



Stereopsis - highest refinement of visual system



The eye is part of the brain.

Corresponding images from nasal and temporal sides of retina are brought together in visual cortex at rear of brain.

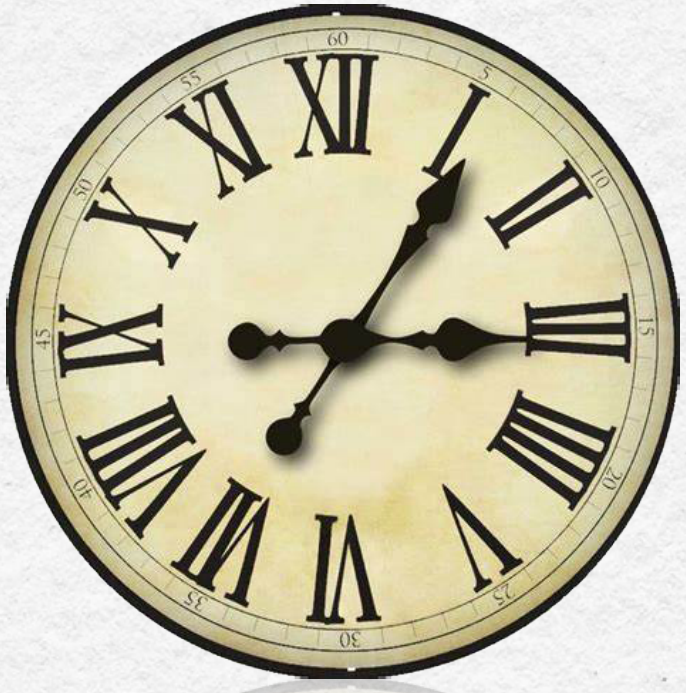
Stereopsis is final visual development to take place in young child.

After age 5-6 difficult to rectify if not present.

Enemies

Ultraviolet Light

Time



Any Questions?