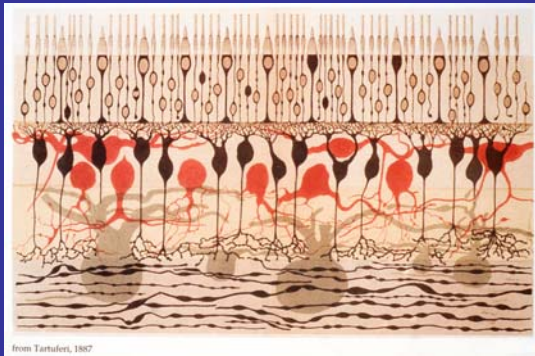


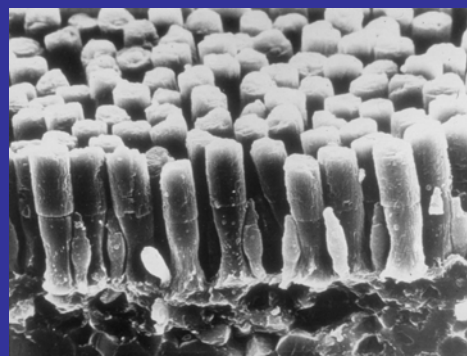
Ectopic expression of the eyeless or twin-of-eyeless genes produces ectopic eyes



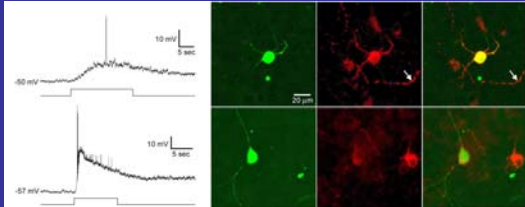
The vertebrate retina



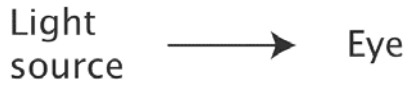
Rod and cone photoreceptors



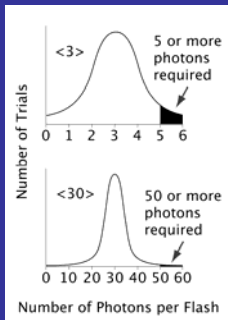
Intrinsically photosensitive retinal ganglion cells



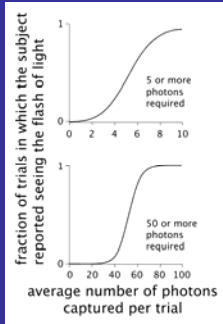
Determining the absolute threshold for vision



Determining the absolute threshold for human vision: 1



Determining the absolute threshold for human vision: 2



If we convert the energy of dropping a dime by 1 mm into photons, how many photons would we have?

Energy lost by dropping a dime 1 mm in the Earth's gravitational field

$$10^{-3} \text{ kg} \times 9.8 \text{ m/sec}^2 \times 10^{-3} \text{ m} = 9.8 \times 10^{-6} \text{ Joules}$$

Energy / 500 nm photon

$$= h\nu$$

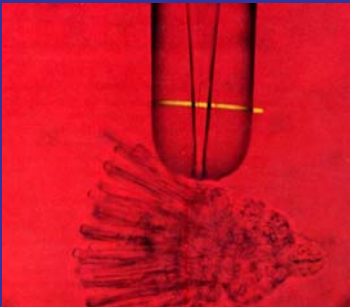
$$= h \times (c / \text{wavelength})$$

$$= 6.6 \times 10^{-34} \text{ Joule sec} \times (3 \times 10^8 \text{ m/sec} / 500 \times 10^{-9} \text{ m})$$

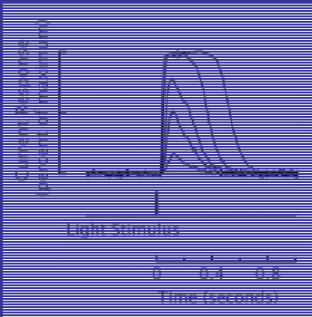
$$= 4 \times 10^{-19} \text{ Joules}$$

Result: we would have 2.5×10^{13} photons !

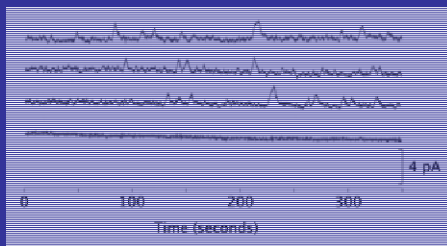
Recording current flowing into a single rod outer segment



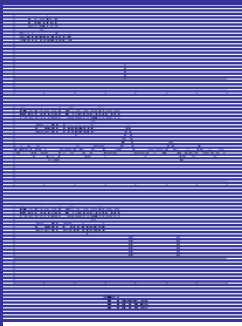
The electrical response of a single rod to a flash of light



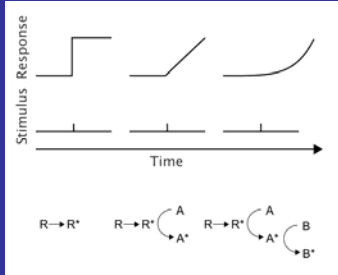
In complete darkness a rod produces electrical events that resemble single photon responses



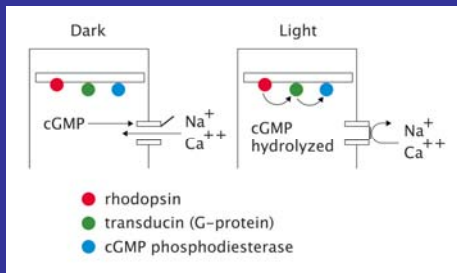
A retinal ganglion cell responds to a dim flash of light

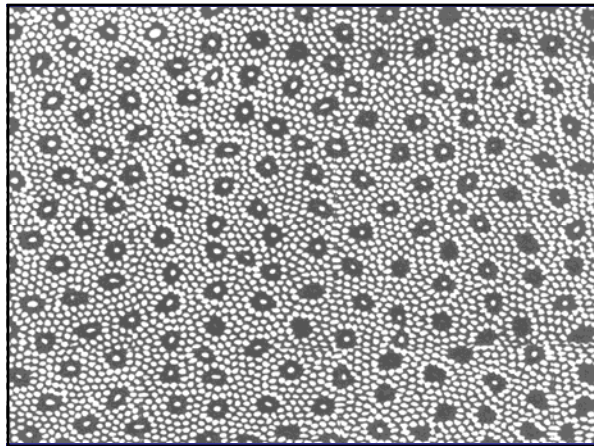


An engineer's view of signal amplification in sensory receptors

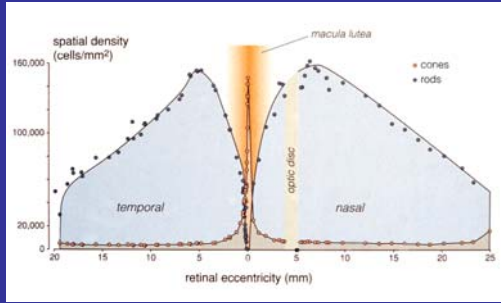


The amplification cascade in vertebrate photoreception

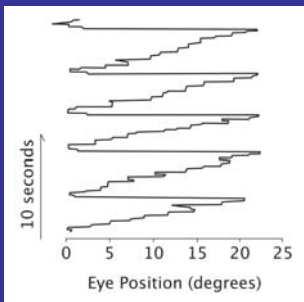




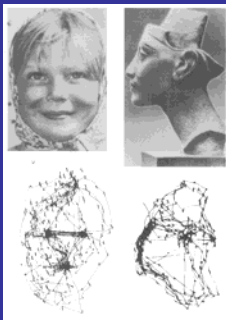
Cones are concentrated in the center of the human retina



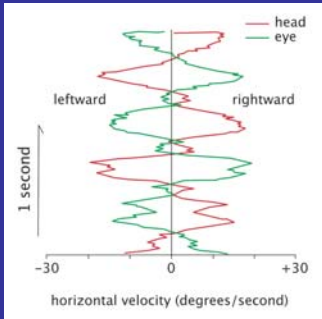
Eye movements during reading



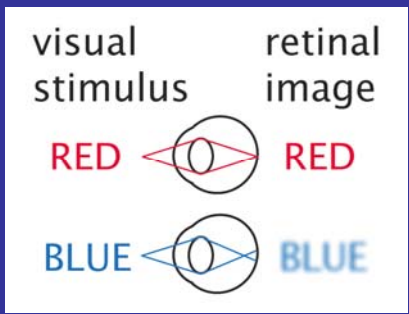
Eye movements while viewing faces



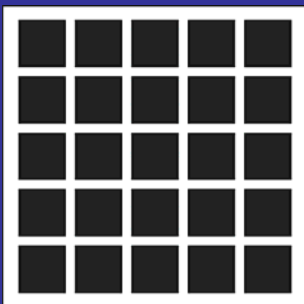
Complementary eye and head movements while walking



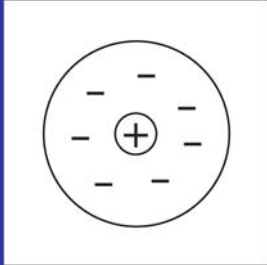
Chromatic aberration in the human eye



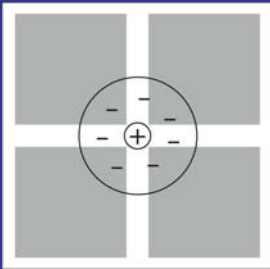
The Hering illusion



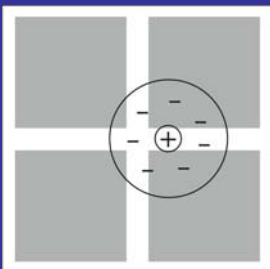
Antagonistic center-surround receptive field of a retinal ganglion cell



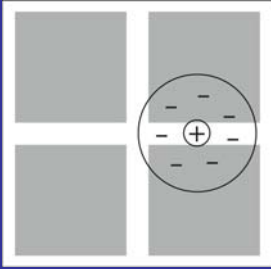
The Hering illusion explained



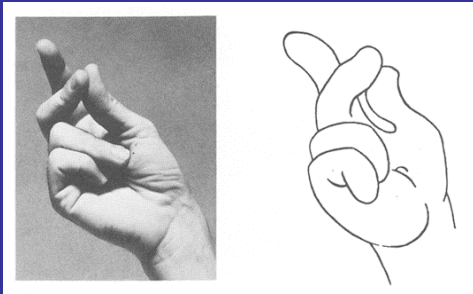
The Hering illusion explained



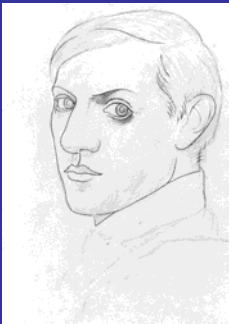
The Hering illusion explained



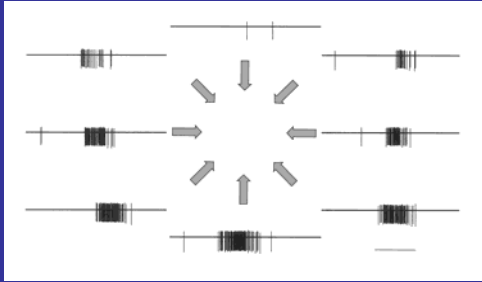
The remarkable effectiveness of line drawings



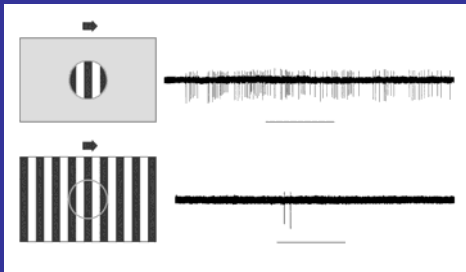
The remarkable effectiveness of simple portrait sketches



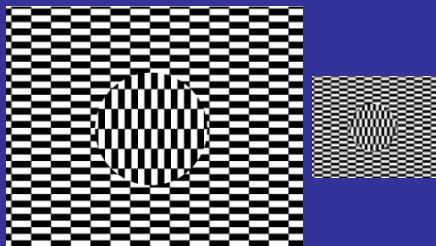
Responses of a directionally selective retinal ganglion cell



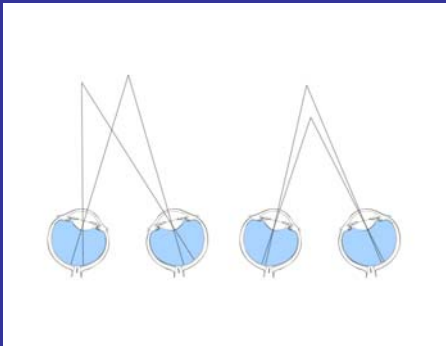
A retinal ganglion cell that responds to local but not global motion



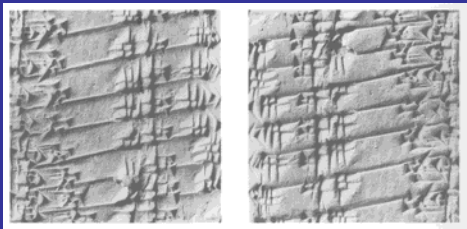
The Ouchi illusion



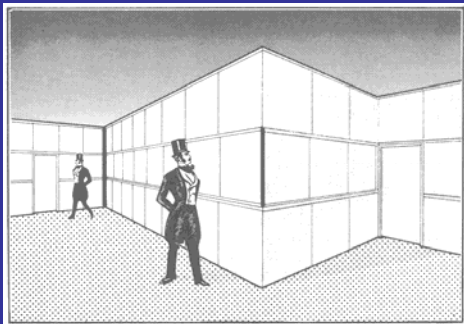
Stereoscopic depth perception



Depth from shading and the hidden assumption of light from above



Depth judgments affect our assessment of absolute size



Organizing the scene:
a vase or Prince Philip and
Queen Elizabeth?



It still looks like a bull

