Imaging

Image: a visual representation in form of a function $f(x,y)$, where f is related to brightness (or color) at a point (x,y).

Most images are defined as a rectangle.

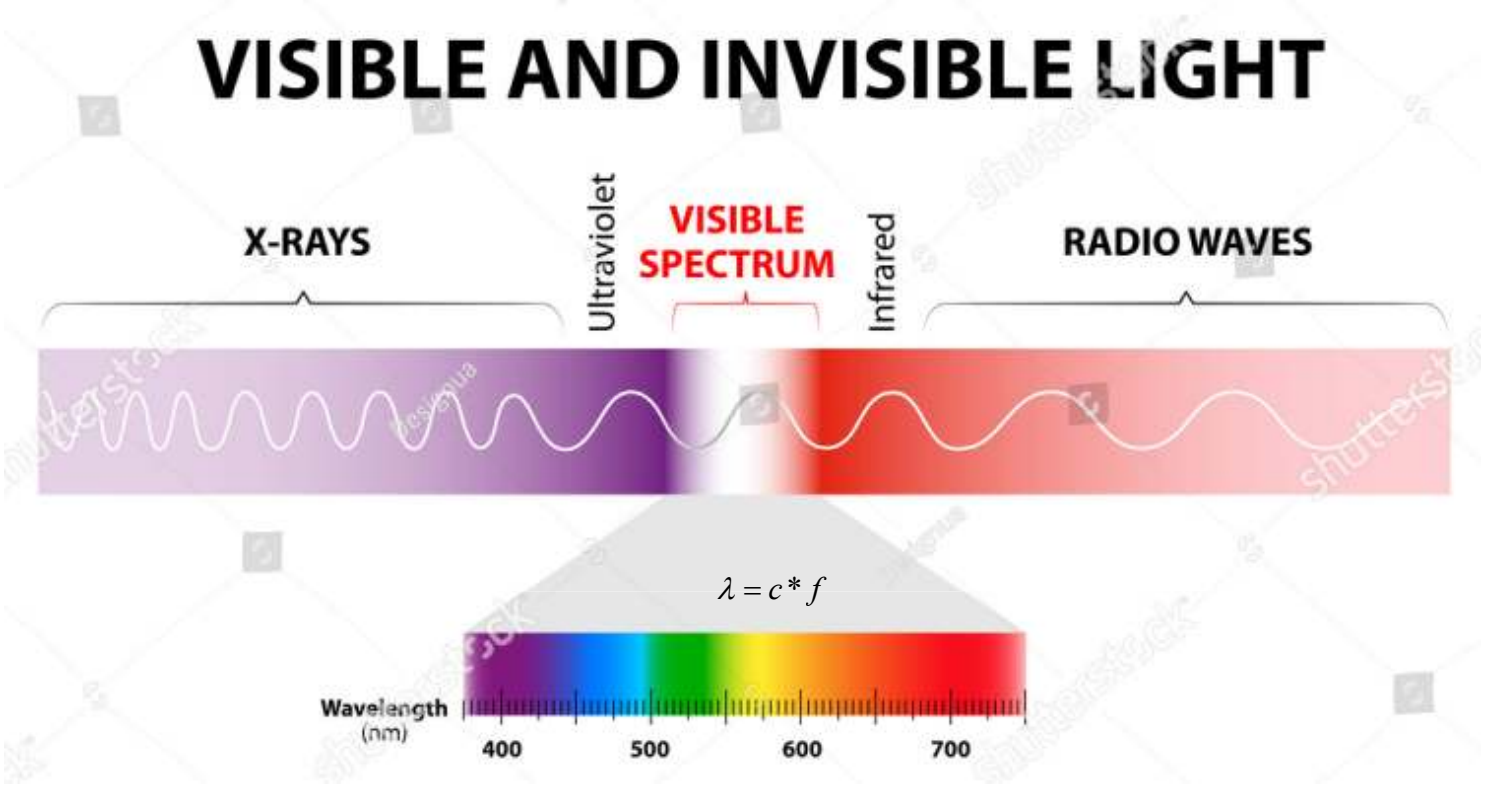
Continuous in amplitude and space.

Digital Imaging

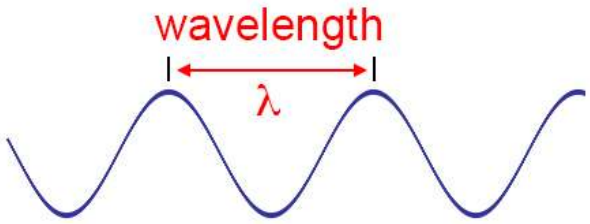
54	58	255	8	0
45	0	78	51	100	74
85	47	34	185	207	21	36
22	20	148	52	24	147	123
52	36	250	74	214	278	41
	158	0	78	51	247	255
		72	74	136	251	74

Digital Image: discrete samples *f[x,y]* representing a continuous image *f(x,y).*

Each element of the 2-d array f[x,y] is called a pixel or pel.



$$\lambda = c / f$$

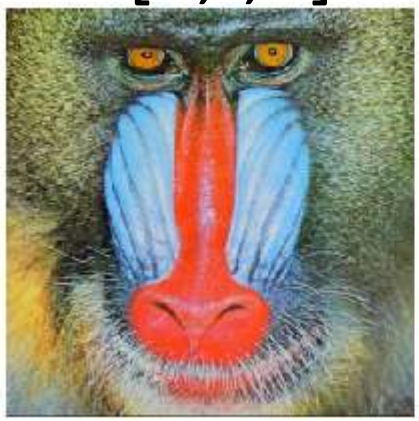


$$E = h * f$$

λ: Wavelength
f: Frequency
c: speed of light (2.998×10^8 m/s)

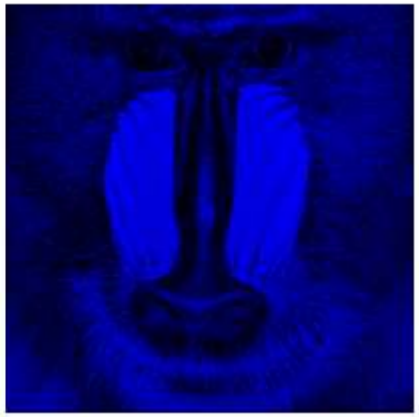
E: Enengy
f: Frequency
h: Planck's constant (10^{-6} m)

F[X,Y,3]



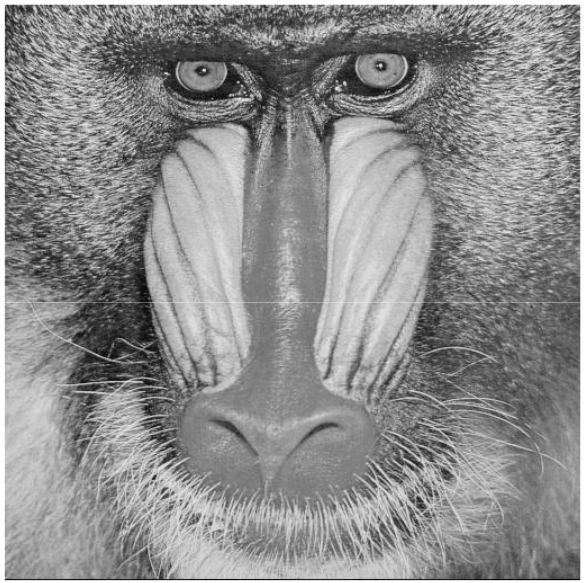
F[X,Y,1]=R[X,Y]

F[X,Y,2]=G[X,Y]



F[X,Y,3]=B[X,Y]

Monochromatic

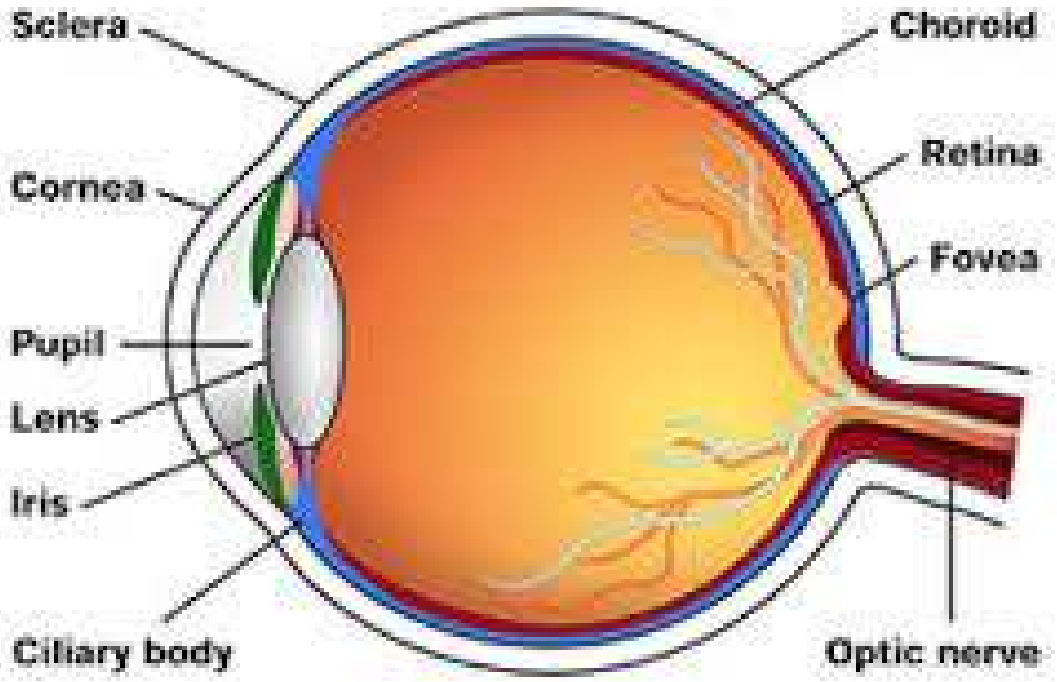


R[X,Y]=G[X,Y]=B[X,Y]

Characteristics of an Image

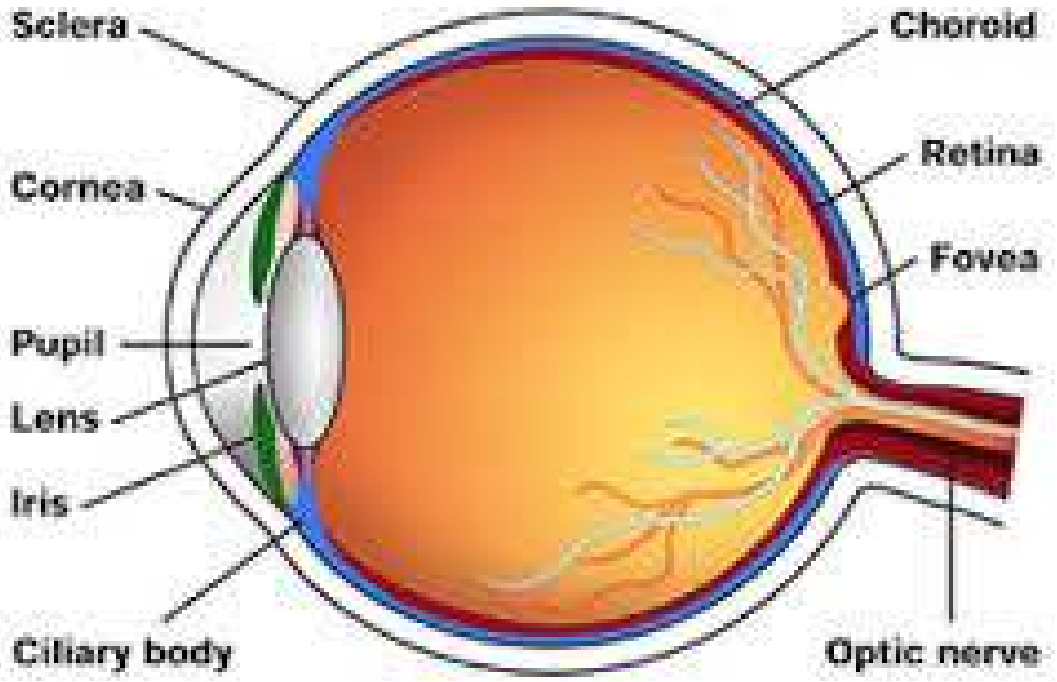
Spatial Resolution: Related to the number of pixels that compound an image.

Human Visual System



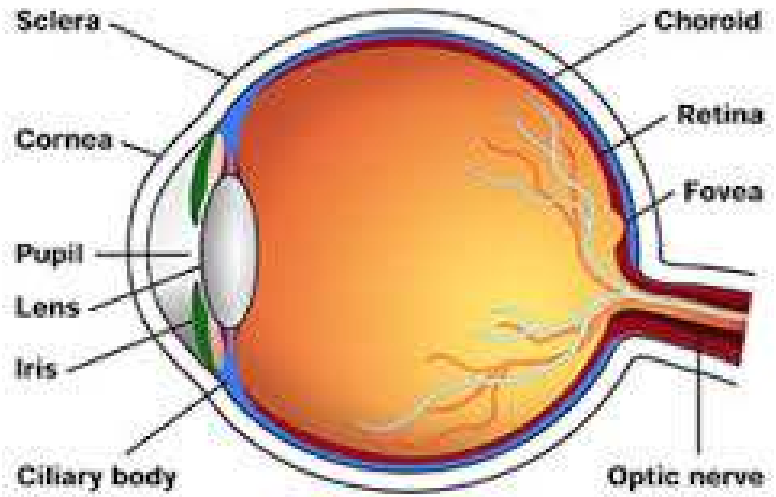
The Eye is a sphere enclosed by three membranes: the cornea and sclera outer cover, the choroid, and the retina.

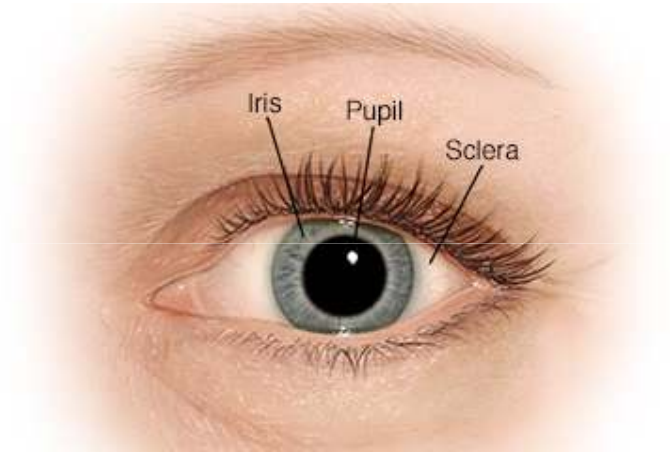
Human Visual System



The cornea is transparent and functions like a window that controls and focuses the entry of light into the eye.
The sclera is a protective membrane to the eye (White).

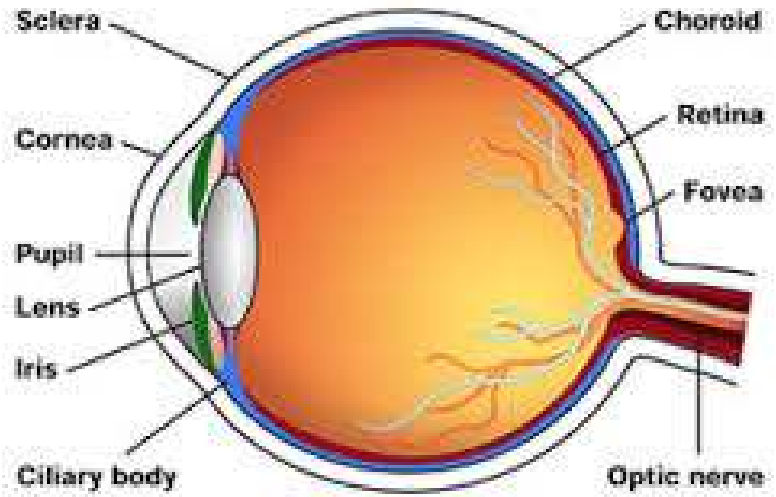
Human Visual System

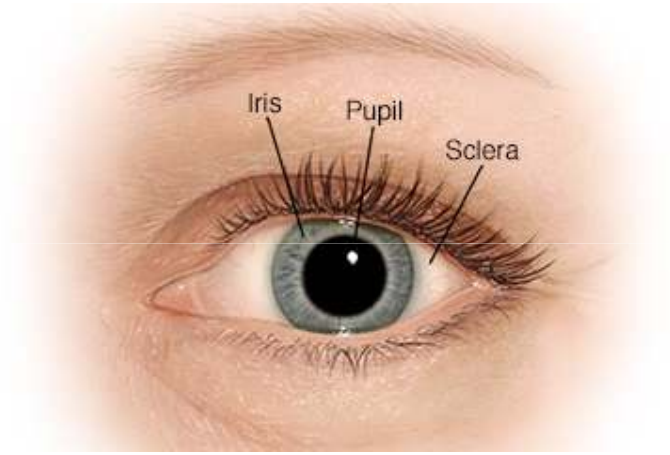




The choroid is divided into the ciliary body and the iris.
The iris contracts or expands to control the light that enters the eye. The central opening of the iris (the *pupil*) varies in diameter from 2 mm to 8mm.

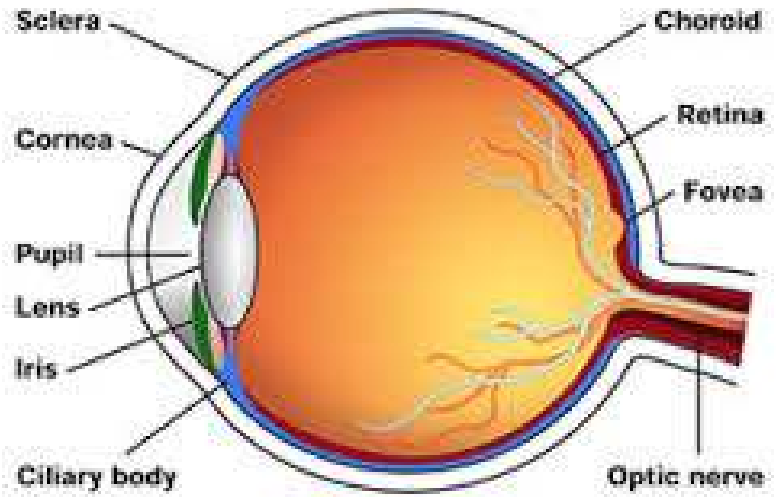
Human Visual System

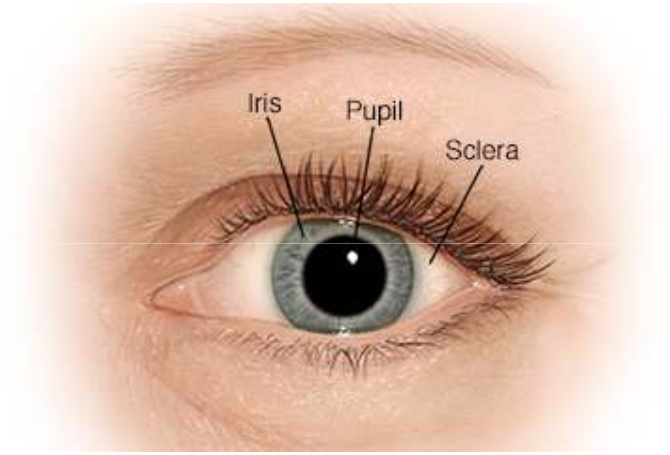




The choroid is divided into the ciliary body and the iris.
The iris contracts or expands to control the light that enters the eye. The central opening of the iris (the *pupil*) varies in diameter from 2 mm to 8mm.

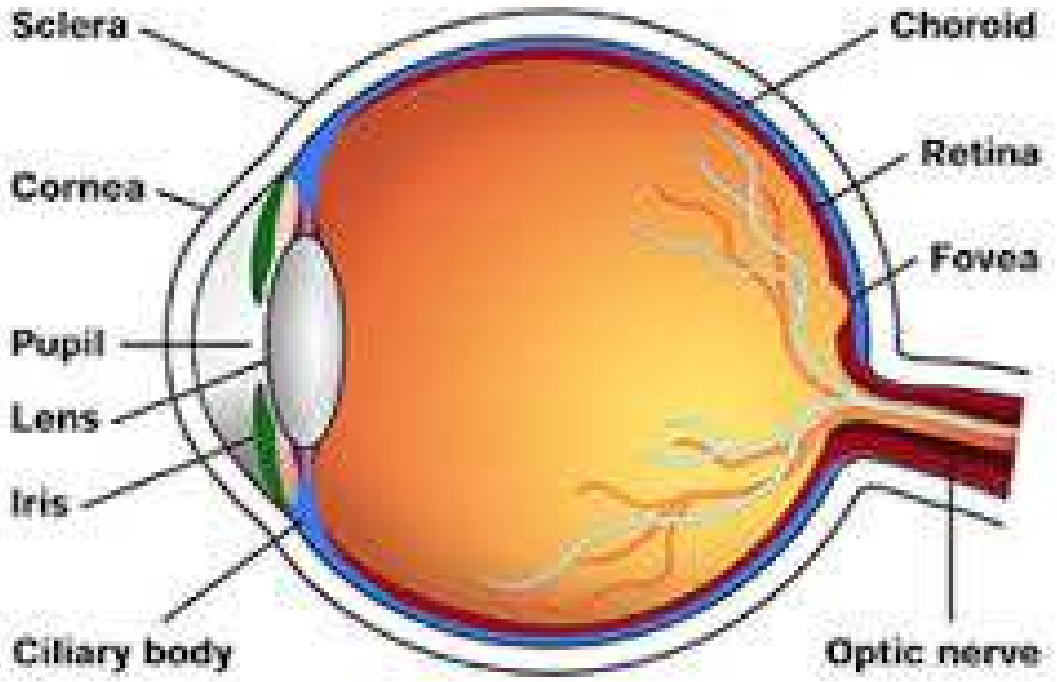
Human Visual System





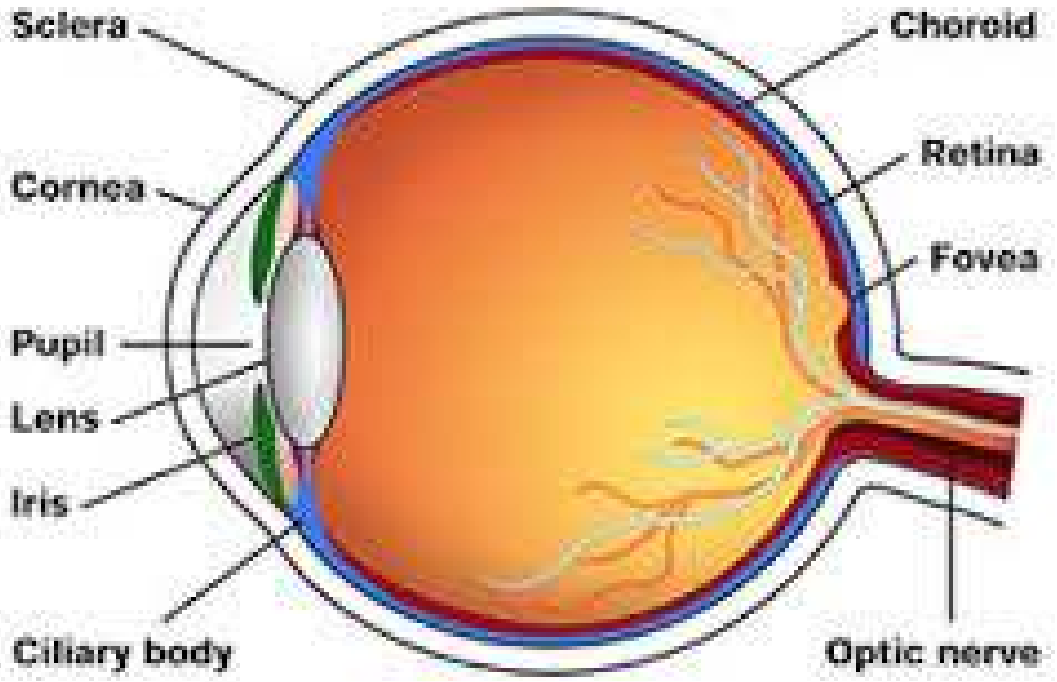
The choroid is divided into the ciliary body and the iris.
The ciliary body produces the fluid in the eye called aqueous humor. It also contains the ciliary muscle, which changes the shape of the lens when your eyes focus on a near object. This process is called accommodation.

Human Visual System



The lens consists of concentric layers of fibrous cells. It filters 8% of the visible spectrum light (infrared and ultraviolet). By changing its shape, the lens focuses light onto the retina. Through the action of small muscles (called the ciliary muscles), the lens becomes thicker to focus on nearby objects and thinner to focus on distant objects.

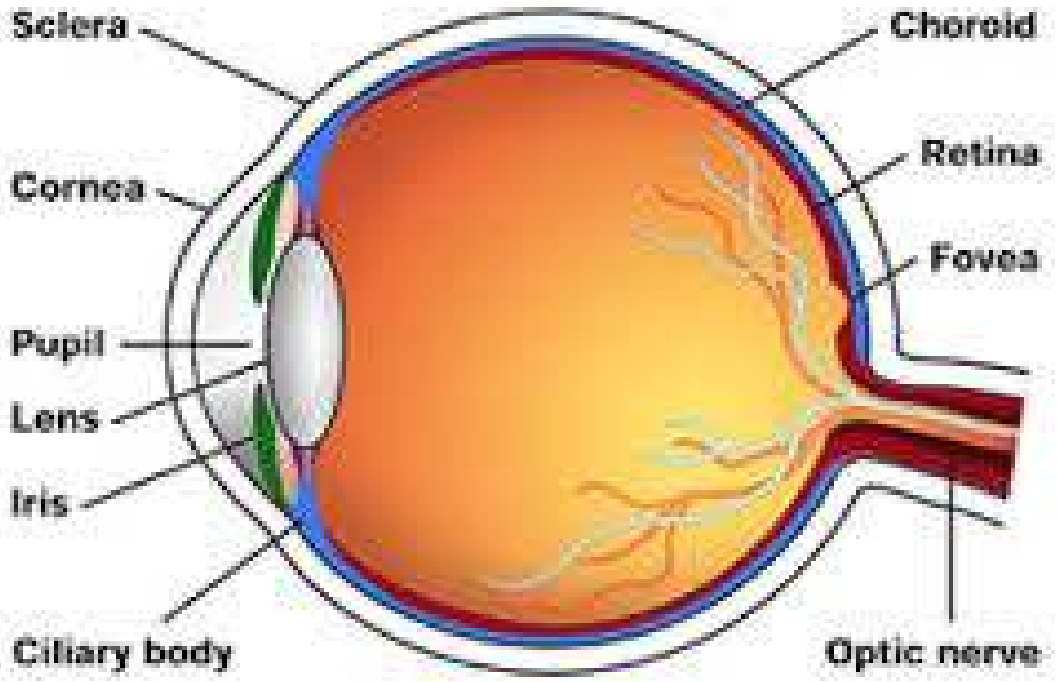
Human Visual System



The **retina** contains the cells that sense light (photoreceptors) and the blood vessels that nourish them.

The **photoreceptors** in the retina convert the image into electrical signals, which are carried to the brain by the optic nerve.

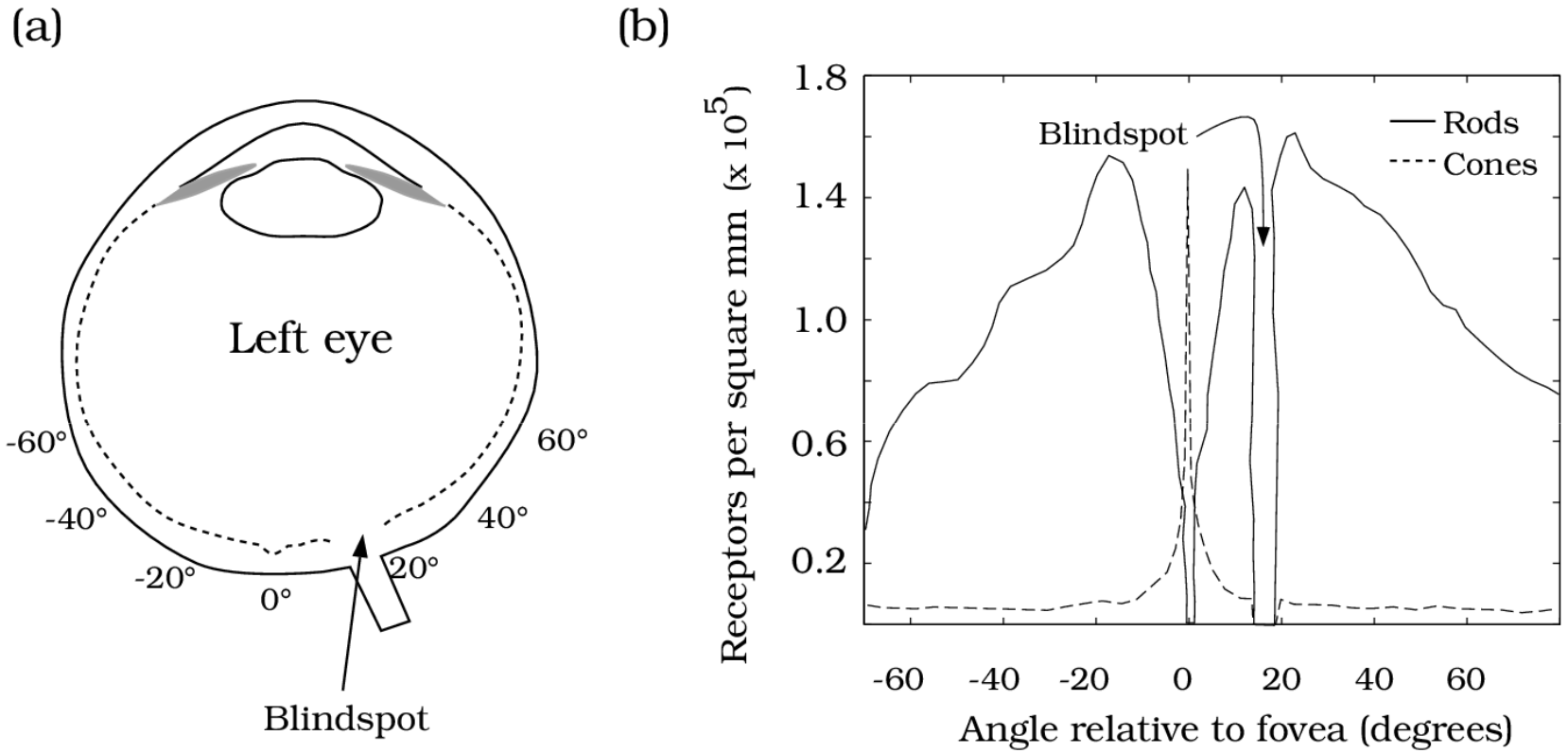
Human Visual System



Cones are responsible for sharp, detailed central vision and color vision and are clustered mainly in the macula.

Rods are responsible for night and peripheral (side) vision. Rods are more numerous than cones and much more sensitive to light. Rods are grouped mainly in the peripheral areas of the retina.

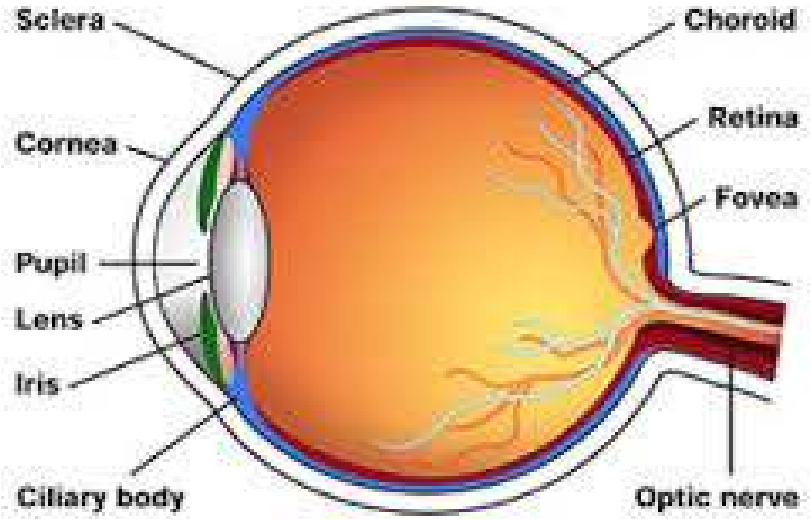
Human Visual System

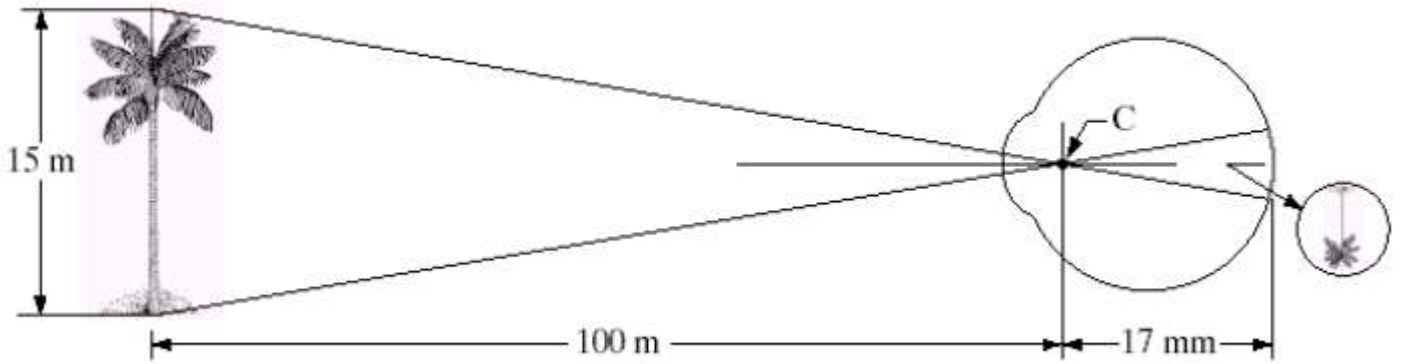


The fovea is about 1.5 mm in diameter ~area of 1.77 mm^2 .

155,000 elements / mm^2

#elemens(fovea)=155,000 elements / mm^{2*} 1.77 mm^2 =265,500





Distance between center of lens and retina (focal length) vary between 14-17 mm