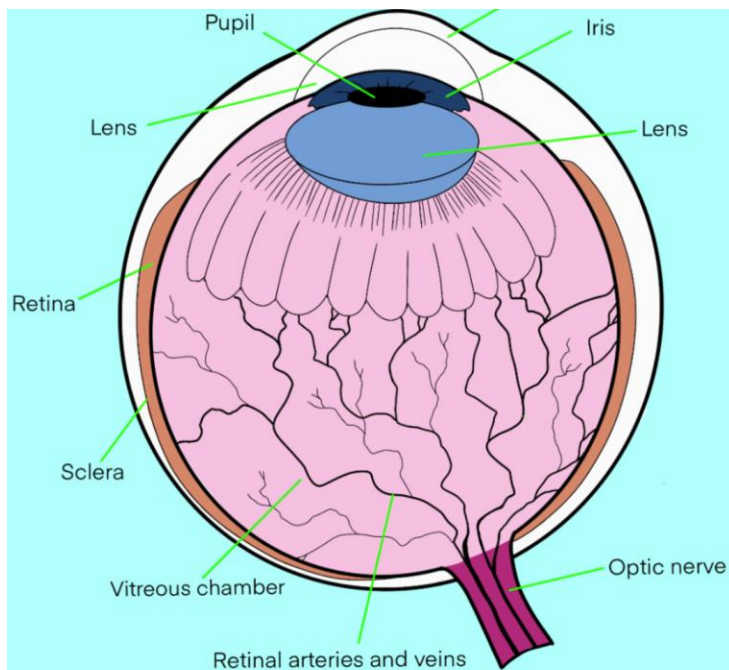


Look Inside



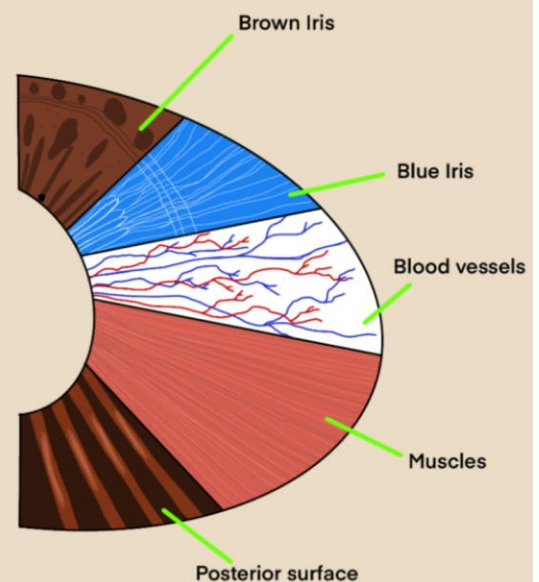
A manual about vision and the eyes

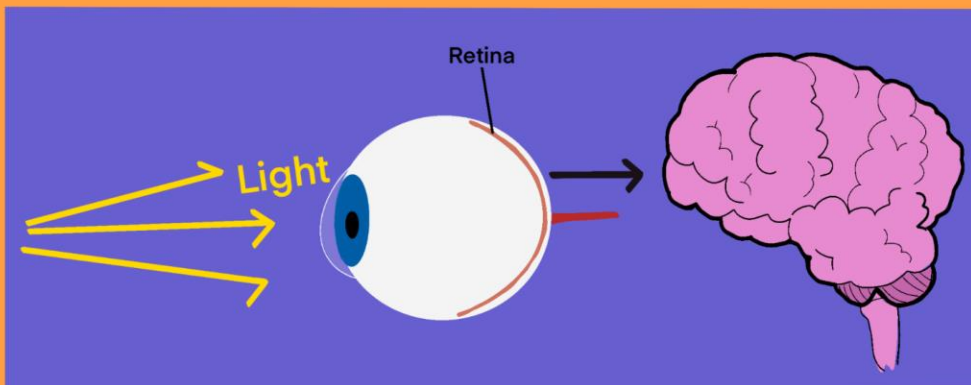
Written and illustrated by
Kailah Heller



Vision is the ability for the eye and brain to interpret light and produce an image. We are able to use the structures within the eye to communicate to our brain what we see. The anatomy of the eye is the first component to understanding how vision works.

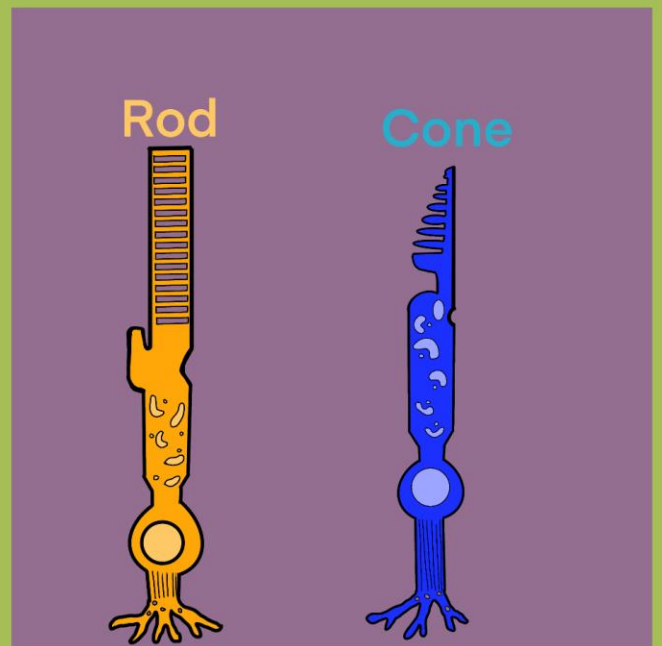
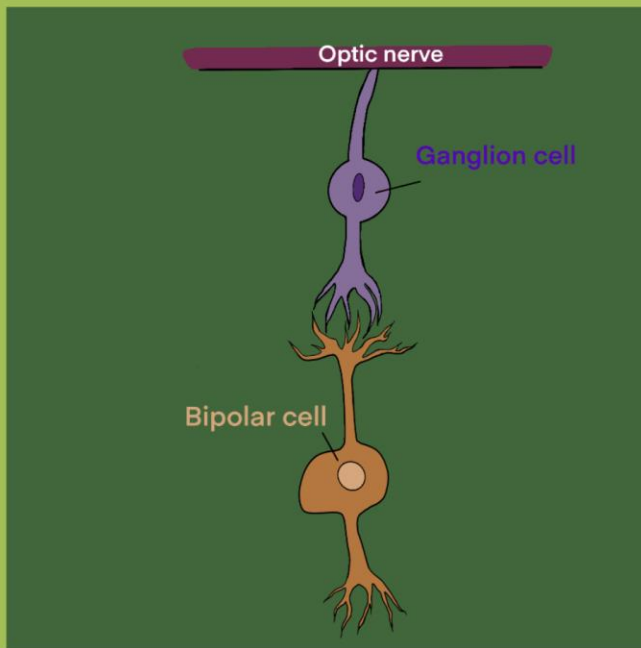
The eye is analogous to a camera where the lens is able to dilate and constrict to let in certain amounts of light. The iris surrounds the pupil and controls the amount of light that enters the eye. The retina is where the rods and cones are located which are receptors. Light contacts the photo receptors and is absorbed and transformed into electrical impulses that are conducted and relayed to the brain via the optic nerve. (John Hopkins Medicine) 2009





When waves travel to the eye, we are only able to perceive a fragment of the whole electromagnetic spectrum. This is called the visible light spectrum and lies between 380 NM and 740 NM according to (Openstax) 2012

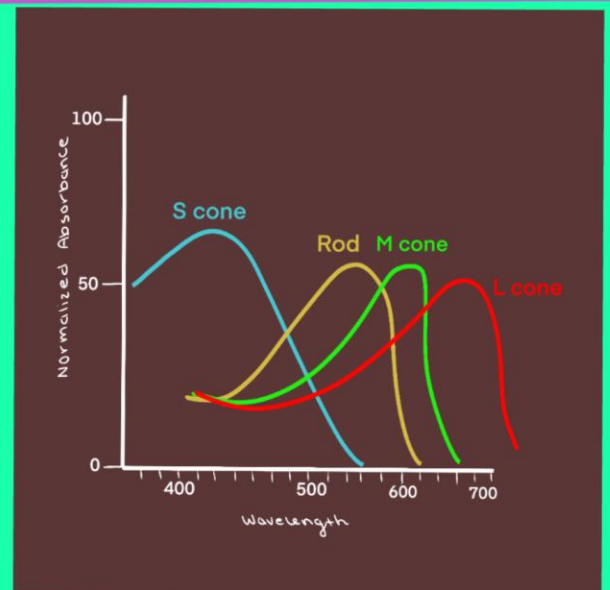
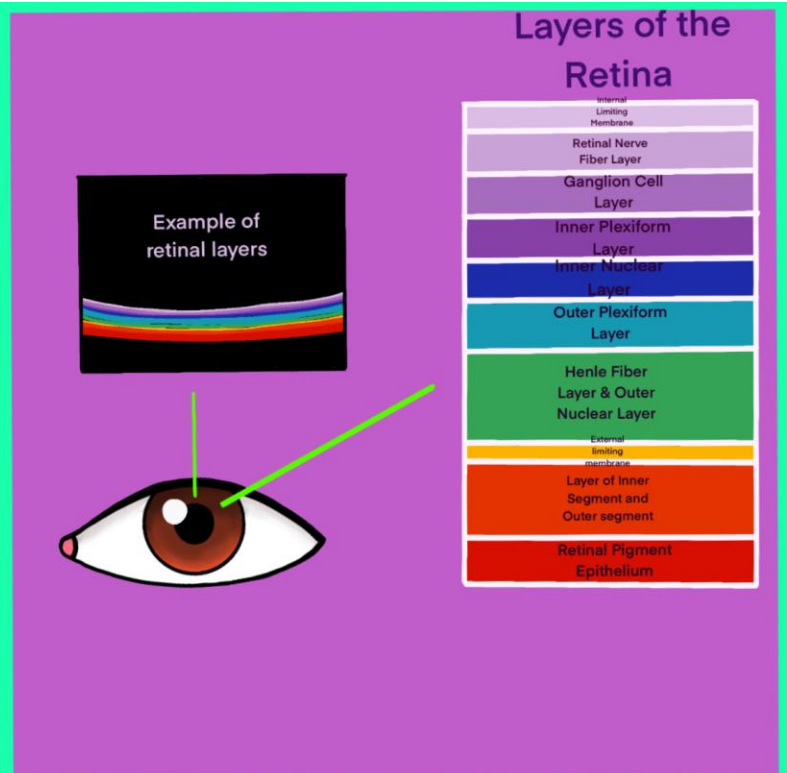
Kristina Irish (JHU) 2009, stresses the importance of the retina and its role in vision. Light is picked up by the retina and sets off a series of events that sends signals to the brain through various cells.

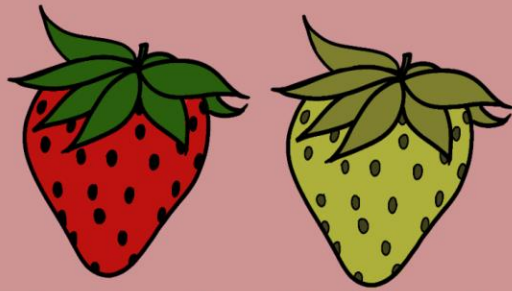


The retina gets information from the light waves and the electrical conduction moves through the optic nerve, then ganglion cells, bipolar cells, and finally the rods and cones. This process results in visual information in the brain which allows us to "see". Atsunobu from UOB also goes into detail about the retina, transforming light through primary functions light color sampling, neural connections and cell positioning. (Atsunobu)

2025

The retina is comprised of multiple layers, which also serve a vital function in eyesight. In terms of color vision, it is noted in the journal written by Liu, that the cones in our eyes are what interprets to our brain the light spectrum and therefore color. The three types of cones in our eyes perceive different light waves. S cone being the fastest wavelength (blue), and L cones being the slowest (red). It is also argued in the paper that the cortex has the capability and task of color dimensionality. (Liu) 2024





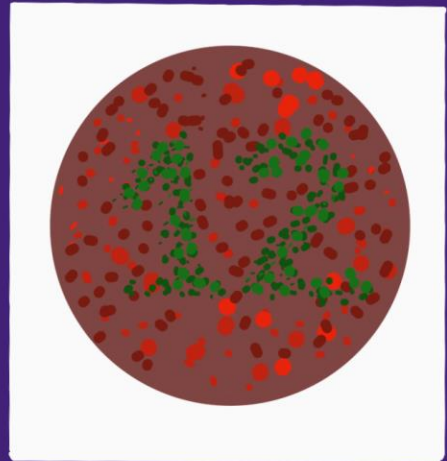
Trichromatic Dichromatic

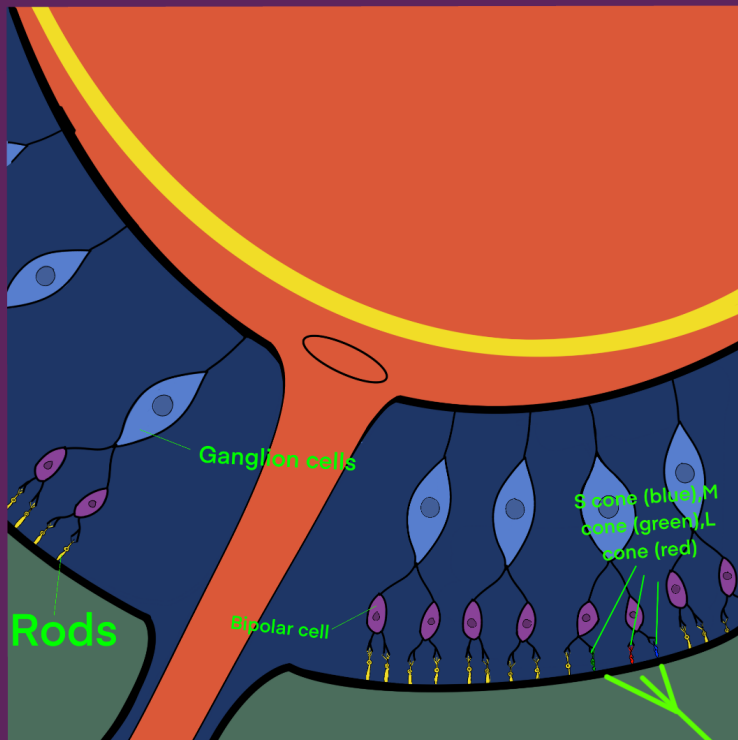
Visual example of a type of color blindness

When the cones within the eye do not function properly, color blindness occurs.

The type of color blindness is determined by which cones are properly functioning since as mentioned previously, each cone perceives different colors or visual wavelengths

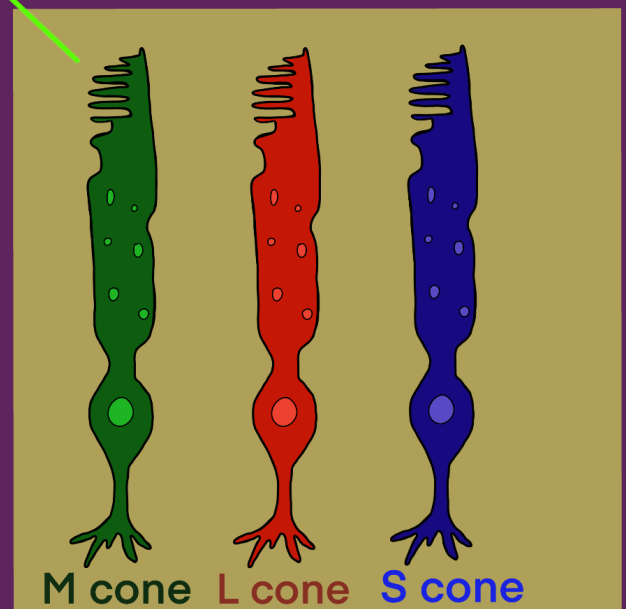
Color tests such as this one are used to diagnose color blindness



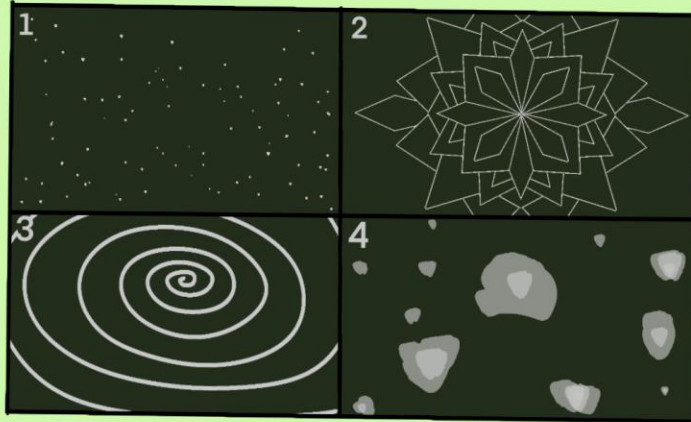


The electrical signals must be passed through the the chain, starting with the ganglion cells and ending with the cones and rods.

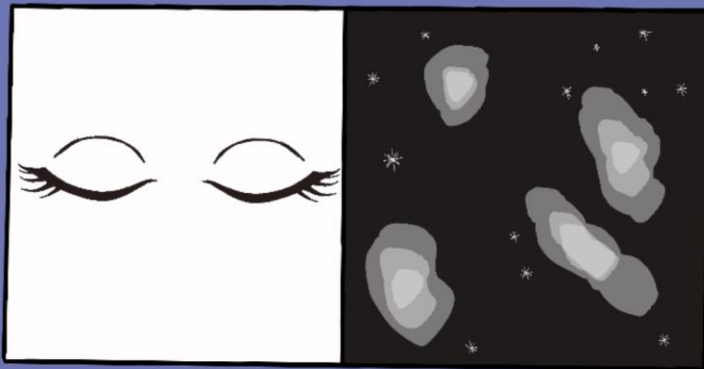
The rods and cones are located beyond the bipolar cells, and once the light hits the cells, color can be perceived in the brain



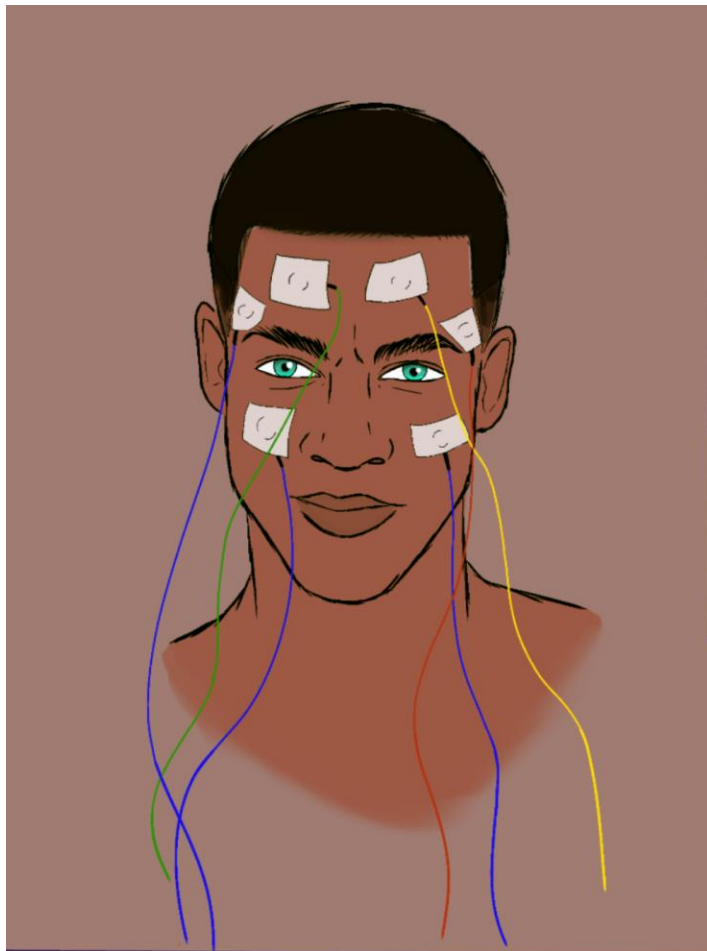
Examples of Phosphenes



Migraine Induced Phosphenes



Phosphenes are a phenomenon that happens in the eye where people can sometimes see light, shaped, or spots when their eyes are closed. This typically happens in the absence of light, contrary to the belief that a light source is needed in order to see things. There are multiple ways that Phosphenes are induced. One way in particular is through a phosphenotron, a device using currents to stimulate Phosphenes. (Sadrzadeh- Afsharazar) 2024 The study was meant to explore the potential use of Phosphenes to progress vision prosthetics.

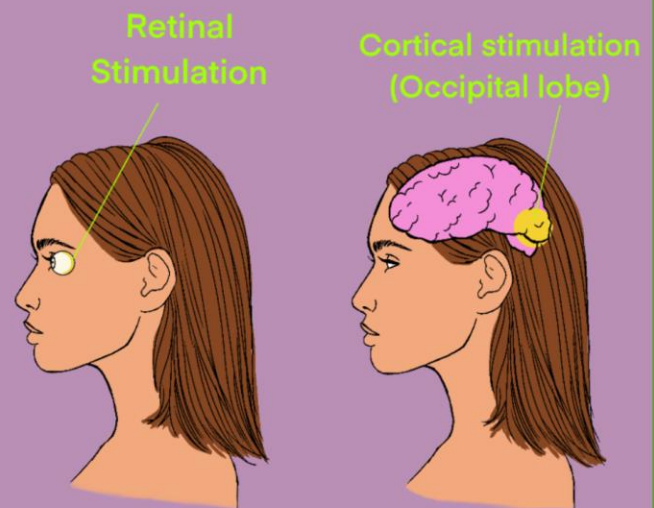


Rubbing or
pressing eye



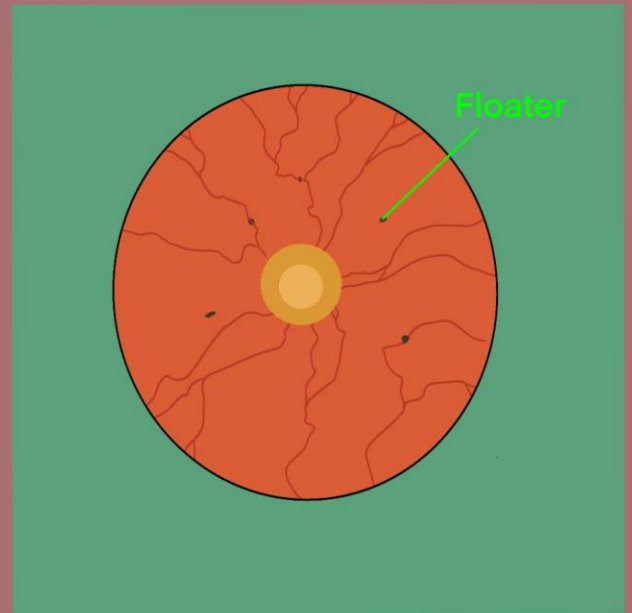
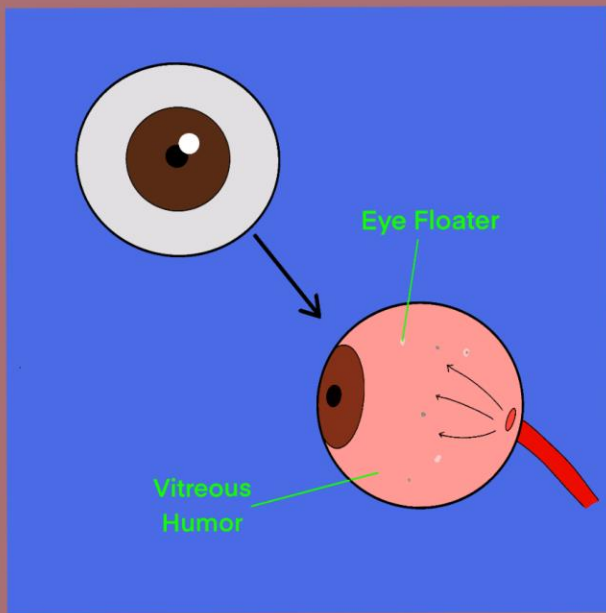
Other ways that phosphenes can be induced include but are not limited to rubbing or pressing on the eye, electrode stimulation, and some illnesses.

Phosphenes occur because of either retinal stimulation (like rubbing your eyes), or cortical stimulation (electrodes sending currents).



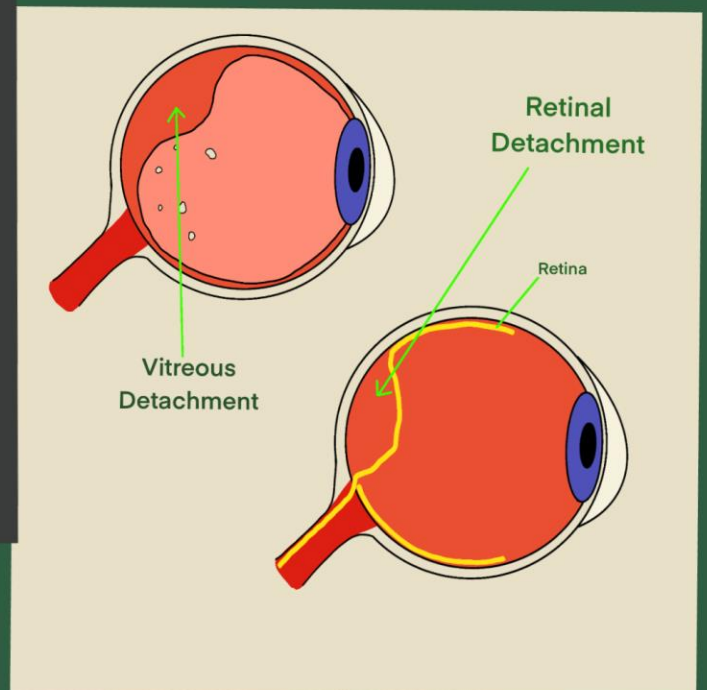
Vitreous Floaters	Phosphenes
 Occurs when eyes are open	 Occurs when eyes are closed
 Light needed for visibility	Absence of light needed for visibility

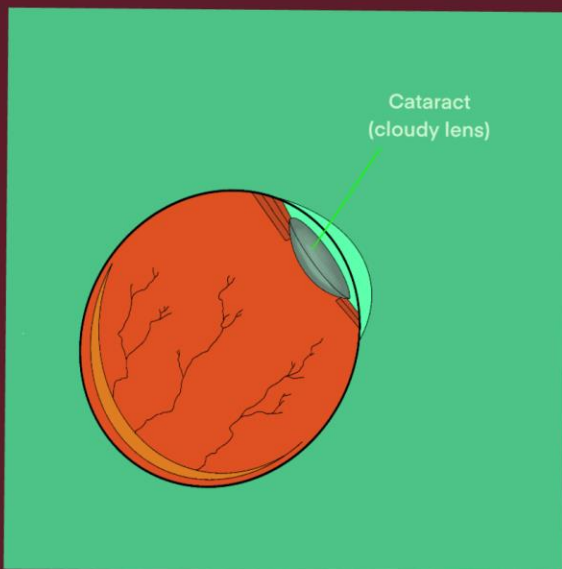
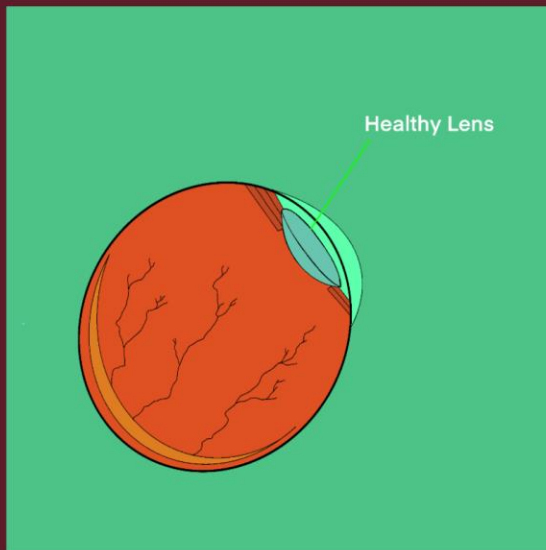
There is another condition where you can sometimes see spots in vision that are called eye floaters or vitreous floaters. (Rochester) 2024 describe them as black or gray specs, strings or cobwebs that may drift when you move your eyes and appear to dart away when you look at them directly.



According to Rochester, eye floaters are due to the vitreous (jelly like substance that helps maintain the eyes round shape) changing as we age. It could also be due to torn retina or bleeding in the eye.

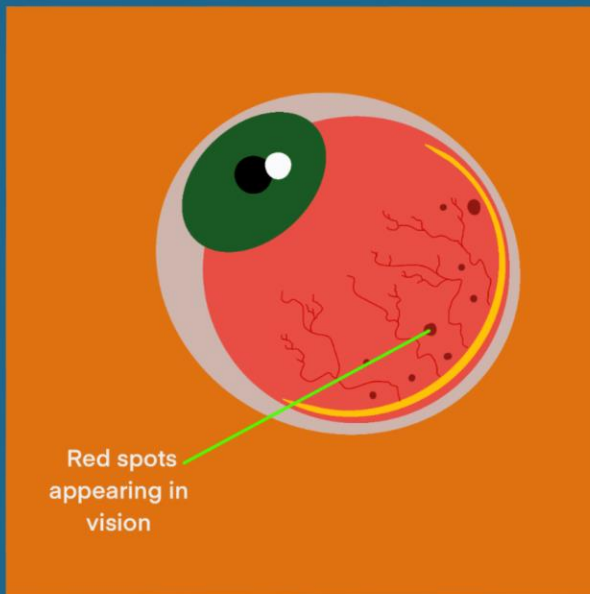
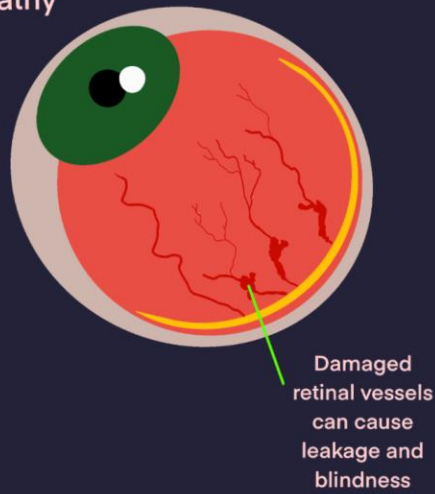
Eye floaters can be present when the vitreous detaches, which casts a shadow to the retina, thus resulting in eye floaters. If the retina detaches it could also present the same result. It should also be noted that floaters are normal, but when they become obstructive, there may be a problem with the eye anatomy.





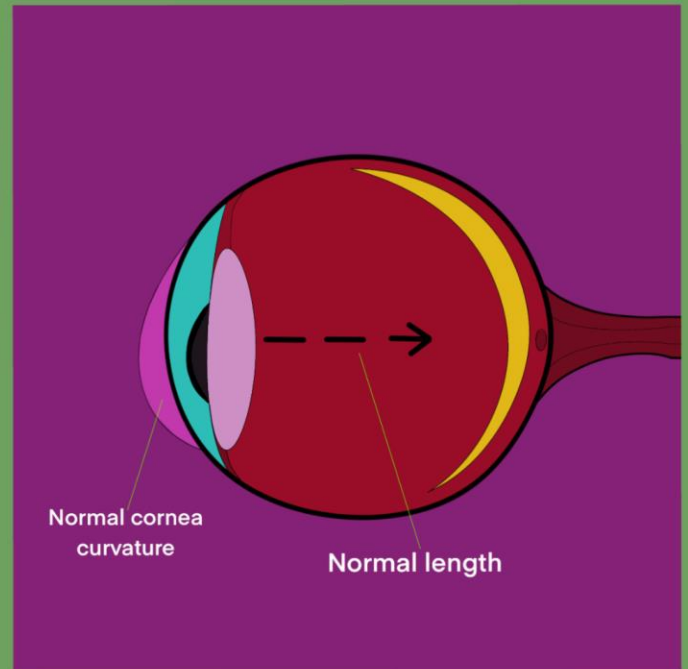
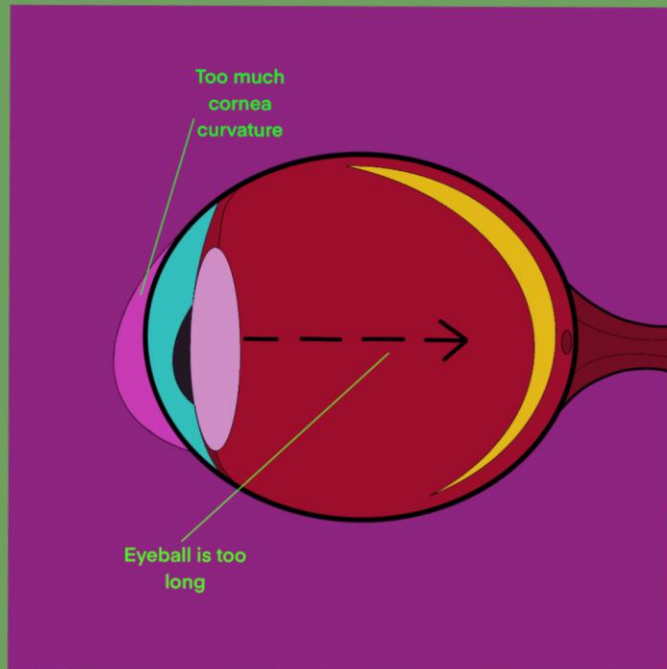
There are disorders of the eye that caused visual impairment. In some cases, they also require surgical intervention. One of those diseases are cataracts. (Alswaina) 2025 States that a cataract is when the lens of the eye becomes opaque, which results in difficulty to see. It also mentions that cataracts are a common eye disease specifically in poor regions.

Diabetic Retinopathy



Retinopathy is a condition affecting blood vessels in the eye can cause bleeding, fluid, leakage, and vision impairment. It can cause red spots, altered, color, perception, impaired vision, and eye pain. (Tashkandi) 2025 The journal also highlights the importance of detection of an eye disease like retinopathy which can help deter eye impairment. This could also prevent irreversible blindness. Retinopathy most commonly affects people who have been diagnosed with diabetes. This is due to the glucose levels and changes in retinal vessels.

(Tashkandi) 2025

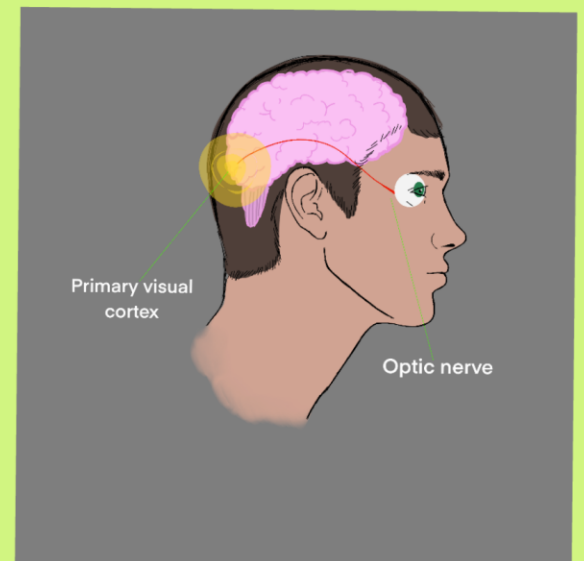


Myopia is described in the journal as a eye condition that is described as the eyeball being longer which affects the way the light reaches the retina and therefore affects vision. Specifically it is mentioned that uncorrected myopia is the primary cause of distance vision impairment worldwide.



In modern science, there has been significant exploration in visual prosthetics. (Farnum) 2021 writes that these devices can help restore a number of abilities such as crude object, recognition and spatial navigation. Specifically electromagnetic devices, nano particles, and genetic magnetic manipulation can help substitute the visual systems.

Since the eye and brain work simultaneously for vision, it is also important to note that there are other prosthetics such as optic nerve prosthetics, and retinal prosthetics that may also aid in vision restoration.



Sources Cited

Eye floaters. (2024). (). Rochester: Tribune Content Agency LLC. Retrieved from Consumer Health Database; eLibrary

Sadrzadeh-Afsharazar, F., & Douplik, A. (2024). A phosphoteron device for sensoric spatial resolution of phosphenes within the visual field using non-invasive transcranial alternating current stimulation. *Sensors*, 24(8), 2512.

Araek, T. (2025). Eye care: Predicting eye diseases using deep learning based on retinal images. *Computation*, 13(4), 91.

Liu, E., He, X., Yue, J., Guan, Y., Yang, S., Zhang, L., . . . Song, W. (2024). MT_Net: A multi-scale framework using the transformer block for retina layer segmentation. *Photonics*, 11(7), 607.

Gisung, S., Joonhong, S., & Mingui, K. (2021). Acute symptomatic vitreous floaters assessed with ultra-wide field scanning laser ophthalmoscopy and spectral domain optical coherence tomography. *Scientific Reports (Nature Publisher Group)*, 11(1)

Nayef, A., & Alayed, F. M. (2025). Public awareness and knowledge of glaucoma and cataract: A cross-sectional study. *Cureus*, 17(4)

Kotani & Ng – ICLR 2025 Conference Paper

Kotani, A., & Ng, R. (2025). *A computational framework for modeling emergence of color vision in the human brain*. In Proceedings of the International Conference on Learning Representations (ICLR 2025). <https://openreview.net>

Frontiers in Neuroscience – Mini Review Article

Author(s). (2020, February 17). [Title of the article]. *Frontiers in Neuroscience*, 14, 36. <https://doi.org/10.3389/fnins.2020.00036>

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